United States Court of Appeals

for the Second Circuit

APPENDIX

75-7621
75-7645

No. 75-7621
No. 75-7645

IN THE

United States Court of Appeals

FOR THE SECOND CIRCUIT

PLANTRONICS, INC.,
Plaintiff-Appellant and Cross-Appellee,

v.

ROANWELL CORPORATION,
Defendant-Appellee and Cross-Appellant.

APPEAL FROM THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK

JOINT APPENDIX — EXHIBIT VOL. II
(Exhibits 122 — XH)
(Pages 400 — 814)

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PAGINATION AS IN ORIGINAL COPY

CONTENTS

* Page numbers on exhibits are informal and are circled.

DEFENDANT'S EXHIBITS

839016

SERIAL NO. (Series of 1960)

Assistant examiner

P R Group		PATENT NUMBER [redacted]
Class	Subclass	DATED

Group No. 232

Filed complete (Date) JULY 3, 1969

Serial No. 839 016

A. Claims Priority Foreign Application

C. Country

D. Application Date

E. Application No.

F. Patent No.

Applicant(s)

HUTCHINGS, KENNETH J. OF SOQUEL, CALIF.

Number claims allowed | Print claim | Class | Subclass

Assignor(s) to Pacific Plantronics, a corp. Santa Cruz, Calif. a corp. of California

Title of Invention

SELF-SUPPORTING HEADSET

CONTINUATION OF | FILED

S.N.

SUBSTITUTE FOR:

Sh. dw.	Total claims	Ind. claims	Filing fee rec.	Transaction	Atty's docket
	4	1	$65 -	01202	A2.546

This is to certify that annexed hereto is a true copy from the records of the United States Patent Office of File Wrapper and Contents of the file identified above.

By authority of the COMMISSIONER OF PATENTS

W. G. Estep
Certifying Officer

Date APR 18 1974

EX. 122

EP10,211

400

[redacted]

Form PO-436 (REV. 6/67)

COMM-DC-55367

839016
SERIAL NO. (Series of 1960)

P.R. Group

PATENT NUMBER 3548118

DATED DEC 15 1970

Assistant examiner

Class 179

Subclass

Group No. 232

Filed complete (Date) JULY 3, 1969

Serial No. 839 016

A. Claims Priority Foreign Application(s) Yes ☐ No ☒
B. Meets conditions specified in 35 USC 119 Yes ☐ No ☐
If "Yes" checked in A and B, complete C, D, E, and F.

C. Country

D. Application Date

E. Application No.

F. Patent No.

Applicant(s)

HUTCHINGS, KENNETH J. ~~of~~ SOQUEL, CALIF.

Number claims allowed	Print claim(s)	Class	Subclass
7		179	156

Assignor(s) to Pacific Plantronics, Inc., Santa Cruz, Calif., a corp. of California.

Title of invention

SELF-SUPPORTING HEADSET

☐ DIVISION OF: FILED — S.N. — GRANTED — PAT. NO.

☐ CONTINUATION-IN-PART OF: S.N. — FILED

☐ CONTINUATION OF: S.N. — FILED

☐ SUBSTITUTE FOR: S.N. — FILED

NONE

☒ NONE

Sh. drw.	Total claims	Ind. claims	Filing fee rec.	Transaction	Atty's docket
2	4	1	$65	01202	A24546

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PARTS OF APPLICATION FILED SEPARATELY

PREPARED FOR ISSUE

(Assistant Examiner) (Docket Clerk)

EXAMINED AND PASSED FOR ISSUE

WILLIAM C. COOPER WCC 232

(Primary Examiner) (Art unit)

Estimate of printed pages

Drawing(s) 1 — Spec(s) — Issue fee due (est.) 401

Notice of allowance and issue fee due (est.)

THIS SPACE RESERVED

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7-3

MAIL ROOM
JUL 3 1969
PATENT OFFICE

839016

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PENINSULA OFFICE
734 MENLO AVENUE
MENLO PARK, CALIF. 94025
(415) 326-0747

July 2, 1969

Commissioner of Patents
Washington, D. C. 20231

Sir:

We are enclosing a patent application in the name of Kenneth J. Hutchings covering a SELF-SUPPORTING HEADSET, together with our check in the amount of $65.00 for the Government filing fee. The filing fee has been determined as follows:

Basic filing fee	\$ 65.00
Extra independent claims (0)	- 0 -
Claims in excess of ten (0)	- 0 -
TOTAL	\$ 65.00

We are also enclosing an assignment from the inventor to Pacific Plantronics, Inc. The cost of recording this assignment is to be charged to our account in the Patent Office No. 06-1300 (Order No. A-24546).

Very truly yours,

FLEHR, HOHBACH, TEST,
ALBRITTON & HERBERT

Aldo J. Test

AJT/bjs
Enc.
Check No. 5074

402

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A-24546

MAIL ROOM JUL 3 1969 U.S. PATENT OFFICE

65-10-10171

839016

Mr. Kennedy 8-19-69

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN that I, KENNETH J. HUTCHINGS, a citizen of the United States of America, residing in Soquel, County of Santa Cruz, in the State of California, have invented certain new and useful improvements in a

SELF-SUPPORTING HEADSET

Abstract of the Disclosure

A self-supporting headset having a housing which accommodates a receiver and microphone. A flexible acoustic tube adapted to communicate between the auditory canal of the ear of a user and the receiver secured to the bottom of the housing, and an adjustable acoustic tube secured to the top of the housing with its distal end adapted to be disposed adjacent the mouth of the user to transmit sound to the microphone.

Background of the Invention

This invention relates generally to headsets and more particularly to headsets which contain a microphone and receiver and are adapted to be supported solely from the ear of the user.

Some prior art headsets have included various intermediate supporting structures for supporting the headset in cooperative relationship with the ear and mouth of the user. Such structures have included head bands and means for attachment to the temple of eyeglasses. These structures have been rather cumbersome. Others have included ear molds for supporting the headset from inside the ear. This necessitates fitting of the ear mold to individual users.

Summary of the Invention and Objects

It is a general object of the present invention to provide a light-weight headset which can be comfortably and securely worn, for example, by telephone operators, radio operators, aircraft personnel or other persons using communications systems.

It is another object of the present invention to provide a headset which is capable of being fitted to the user without undue individual attention.

It is a further object of the present invention to provide a headset which is shaped and constructed to be worn comfortably and stably behind the ear of a wearer.

In general, the above and other objects of the invention are achieved by a headset which comprises a housing adapted to be placed behind the ear of the wearer and including an upper curved extension which extends over and engages the top of the ear. A microphone and a receiver are disposed within the housing. An extensible voice tube is attached and positionably supported from the top of the housing with its distal end adapted to be placed adjacent the mouth of the wearer whereby sound can be transmitted from the mouth to the microphone and a flexible acoustic tube is secured to the bottom and provides communication between the auditory canal of the ear and the receiver.

Brief Description of the Drawings

Figure 1 shows the self-supported headset of the present invention in position upon a user's ear.

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Figure 2 is an enlarged side elevational view of the headset.

Figure 3 is an enlarged view of the headset with one side of the housing removed to show the internal position of the microphone and receiver and the attachment of the acoustic tubes to communicate therewith.

Figure 4 is an enlarged view taken along the line 4-4 of Figure 2 showing the ball and socket connection of the voice tube.

Description of the Preferred Embodiment

Referring to Figure 1, a user 11 is shown with the headset 12 mounted behind his ear 13. The headset includes housing 14 which fits comfortably behind the ear as indicated by the dotted outline 16. The top of the housing 14 includes a horn or projection 17 which extends over the top of and engages the top of the ear to hold the housing 14 in place behind the ear.

The top of the housing 14 supports an extensible voice tube 18 which projects forward from the top of the ear towards the mount of the user with the distal end adjacent the mouth. A flexible acoustic tube 19 is secured to the bottom of the housing and carries ear insert 21. The acoustic tube 19 provides

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communication between the auditory canal of the ear and the receiver. An electrical cable 22 depends downwardly from and is secured to the back of the housing.

Referring more particularly to Figure 2, the voice tube 18 includes telescoped portions 18a and 18b whereby the tube 18 may be extended or retracted to place the distal end 18c adjacent to the user's mouth. The tube 18 is supported from the housing 14 by a ball and socket joint more clearly shown in Figure 4. Thus, the portion 18b is provided with a ball 23 accommodated within socket 24 fitted to the tube 26. The tubes 18 and 26 provide communication between the user and the associated microphone. A ferrule 27 surrounds the ball and socket 23 and 24 and is adapted to detachably secure the voice tube 18 to the housing 14. This is achieved by inserting the ferrule and rotating the ferrule to engage the pins 28. Referring more particularly to Figure 3, the tube 26 is connected to a flexible tube 29 secured to the microphone 31. The flexible tube 29 serves to isolate the microphone 31 from any motion of the housing 14. The tube 26 is held in the housing by epoxy 32 and by the housing when the headset is assembled. The microphone transducer 31 is supported by a resilient boot 33 which serves to support the microphone within the housing and to isolate the same from vibrations of the housing and to decouple the microphone from the receiver.

The flexible tube 19 is supported by grommet member 34 and communicates with the receiver 36. The receiver 36 is also resiliently supported within the housing by a resilient boot 37. The boot likewise serves to isolate the receiver from the microphone and from other vibrations.

The housing 14 may comprise two mating parts which are affixed to one another as, for example, by sonic bonding, pins, or the like. The housing provides receptacles for receiving the microphone and receiver-transducer 31, 36 as indicated.

The cable 22 is secured to the housing by a cover 38 acting in conjunction with the member 39 to form an opening and strain relief 41 secured to the cable and having projection 42. The microphone lead wires 43, 45 extend from the cable and are secured to a pair of pins 44. Receiver leads 46, 47 extend from the cable 22 and are secured to a pair of pins 48. The lead wires from the microphone and from the receiver are attached to socket members (not shown) and are connected to the leads 43, 45 and 46, 47 via pins 44 and 48 when the member 39 is seated within the housing. The socket assembly is held by screw 49 which extends downwardly and engages the nut 51.

Referring now to Figures 1 and 2, it is seen that the headset is self-supporting on the operator or user's ear. The headset fits behind the ear with the projections 17 extending over and engaging the top of the ear. The telescoped voice tube 18 is secured to the top of the housing by a ball and socket joint whereby the tube can be extended and positioned adjacent the wearer's mouth. The weight of the tube serves to provide a counter-clockwise torque to the housing. The flexible tube 19 extends into the ear and provides negligible torque to the housing. However, the cable 22 which depends downwardly has its weight acting on the housing to provide a clockwise torque. The counter-clockwise torque provided by the voice tube and the

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holding action of the protrusion 17 serves to overcome the clockwise torque and to stably hold the headset behind and under the ear of the user. Thus, it is seen that there has been provided a light-weight stably supported headset.

I Claim:

~~CLAIMS~~:

1. A headset comprising a housing adapted to be placed behind the ear of a user and including an upper curved extension adapted to extend over and engage the top of the ear, a microphone disposed in and near the top of said housing, a forwardly extending voice tube communicating with said microphone and positionably secured to the upper portion of said housing, said voice tube being adapted to have its distal end positioned adjacent the user's mouth, a receiver disposed in and near the bottom of said housing, and a flexible tube secured to the bottom of the housing and adapted to provide communication to the auditory canal of the user's ear.

2. A headset as in Claim 1 including a cable secured to the back of said housing for connection to the microphone and receiver.

3. A headset as in Claim 1 in which said voice tube is supported from the housing by a ball and socket joint.

4. A headset as in Claim 3 in which said voice tube includes first and second telescoped sections.

SOLE

DECLARATION, POWER OF ATTORNEY, AND PETITION

I, KENNETH J. HUTCHINGS

declare that I am a citizen of the United States of America

residing at Soquel, County of Santa Cruz, State of California;

that I have read the foregoing specification and claims and I verily believe I am the original, first and sole inventor of the invention in

SELF-SUPPORTING HEADSET

described and claimed therein; that I do not know and do not believe that this invention was ever known or used before my invention thereof, or patented or described in any printed publication in any country before my invention thereof, or more than one year prior to this application; or in public use or on sale in the United States more than one year prior to this application; that this invention has not been patented in any country foreign to the United States on an application filed by me or my legal representatives or assigns more than twelve months before this application; and that no application for patent on this invention has been filed by me or my representatives or assigns in any country foreign to the United States, ~~except as follows:~~

And I hereby appoint FLEHR, HOHBACH, TEST, ALBRITTON & HERBERT, 15th Floor, Hongkong Bank Building, 160 Sansome Street, San Francisco, California 94104, Registration No. 15,929, my attorneys to prosecute this application and to transact all business in the Patent Office connected therewith.

Wherefore I pray that Letters Patent be granted to me for the invention or discovery described and claimed in the foregoing specification and claims, and I hereby subscribe my name to the foregoing specification and claims, declaration, power of attorney, and this petition.

The undersigned petitioner declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Inventor's full name ______________________
(Signature)

Date ______________________

Post Office Address: 3736 Valerea Drive

Soquel, California

Group 330

839016

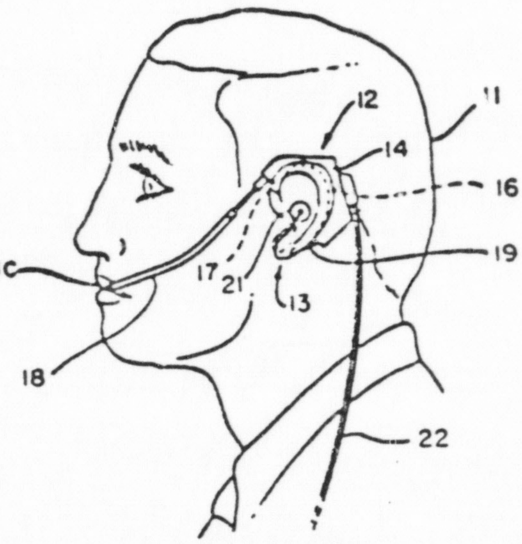

FIG. 1

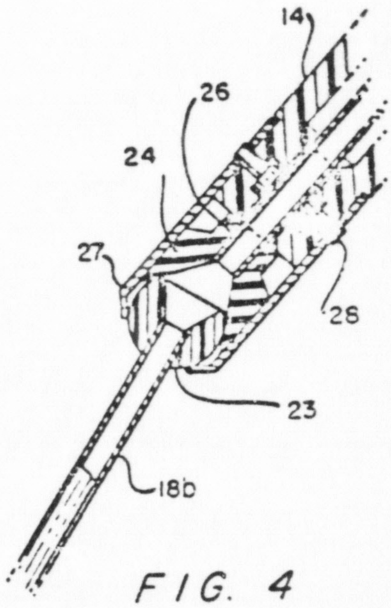

FIG. 4

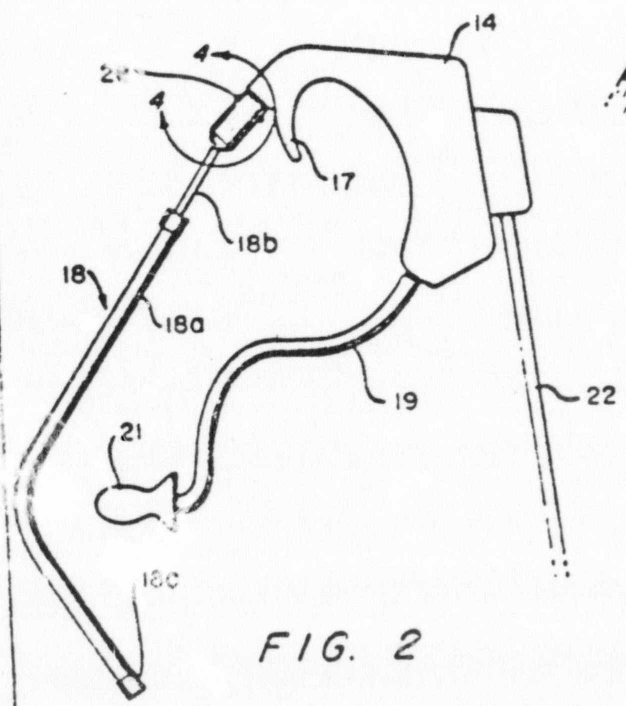

FIG. 2

KENNETH J. HUTCHINGS
INVENTOR

BY [illegible]
ATTORNEYS

411

PRINT OF DRAWING AS ORIGINALLY FILED

Group 230

839016

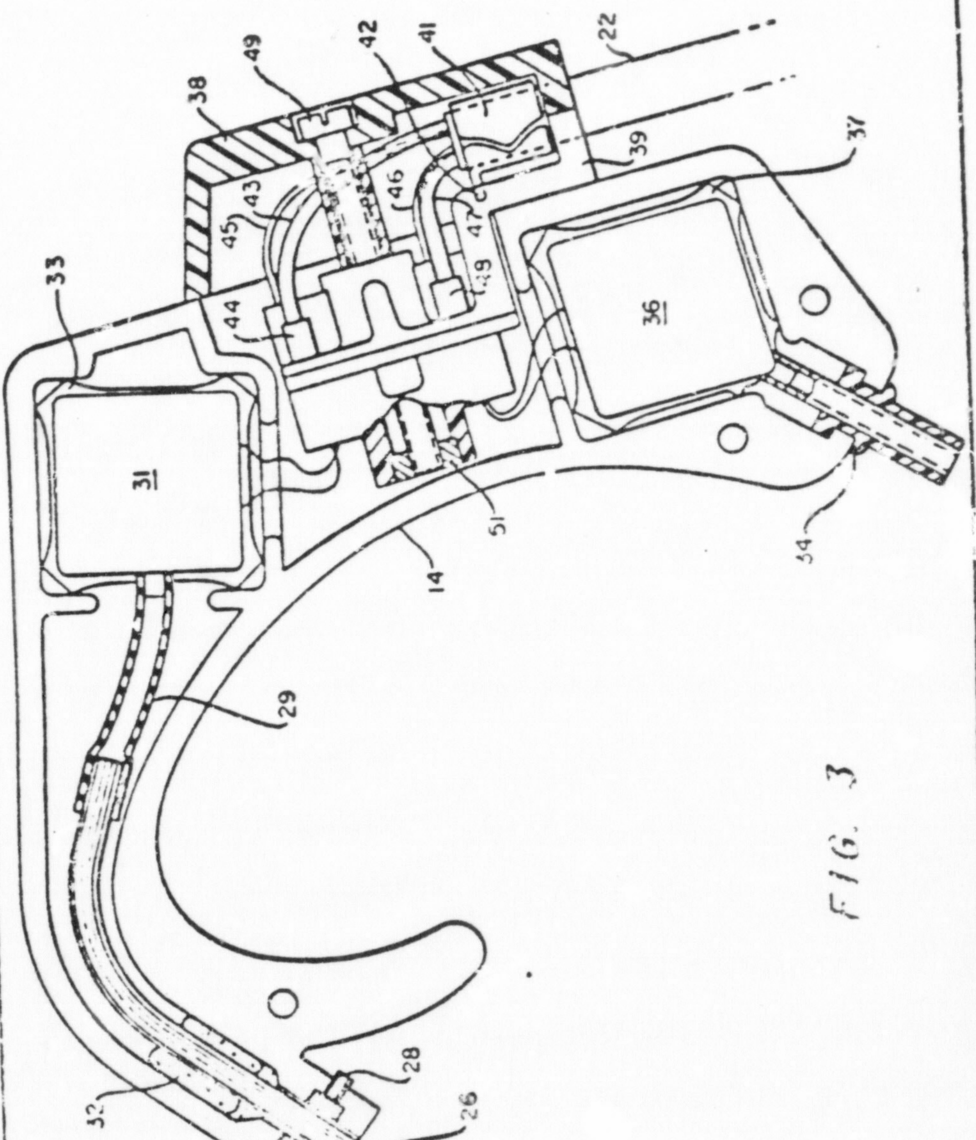

FIG. 3

KENNETH J. HUTCHINGS
INVENTOR

BY

ATTORNEYS

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-24546

DEC 22 1969 MAIL ROOM U.S. PATENT OFFICE

5/010-102-EXAM

RECEIVED JAN 8 1970 GROUP 230

2/a M. Kim 1-12-69

IN THE UNITED STATES PATENT OFFICE

In re application of: KENNETH J. HUTCHINGS Serial No. 839,016 Filed: July 3, 1969 For: SELF-SUPPORTING HEADSET	Group No. 233 Paper No. 2

San Francisco, California

December 19, 1969

PRELIMINARY AMENDMENT

The Commissioner of Patents
Washington, D.C. 20231

Sir:

Please enter the following preliminary amendment in the above entitled application. This amendment is presented to facilitate the examination of the application in connection with the annexed Petition for Advancement of Examination, Rule 102, filed concurrently herewith.

IN THE CLAIMS

Add the following new claims:

a' 5. A headset comprising a housing, a microphone and a receiver disposed in said housing, said housing being shaped to fit behind the ear of a user, said housing including an upper curved extension adapted to extend over and engage the top of

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EFW

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Cont'd

the ear, a forwardly extending voice tube secured to the upper portion of the housing adjacent said curved extension with its distal end adapted to be positioned adjacent the wearer's mouth, said curved extension acting as a pivot whereby the weight of the voice tube provides a torque which counteracts the torque introduced by the weight of the housing to balance the headset and securely hold the same on a wearer's ear.

6. A headset as in Claim 5 including a cable secured to the back of the housing and depending downwardly therefrom providing an electrical connection to the microphone and receiver.

R E M A R K S

Entry of the above amendment is respectfully requested in connection with the Petition for Advancement of Examination.

The costs for the entry of this amendment have been computed to be $10.00. A check is enclosed herewith in that amount. Please charge costs assessed for the entry of this preliminary amendment and not covered by the enclosed check to the account of Flehr, Hohbach, Test, Albritton & Herbert Account No.06-1300, Order No.A-24546.

Respectfully submitted,

FLEHR, HOHBACH, TEST,
ALBRITTON & HERBERT,
Attorneys for Applicant

By Aldo J. Test
Aldo J. Test

Telephone: (415) 781-1989

414

Estimate of printed pages | Issue fee due (est.) 401
Drawing(s) 3 Spec(s) 15 1/2
Notice of allowance and issue fee due (est.)

THIS SPACE RESERVED

DEC 22 1969

A-24546

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RECEIVED JAN 8 1970 GROUP 230

IN THE UNITED STATES PATENT OFFICE

3

In re application of: KENNETH J. HUTCHINGS
Serial No. 839,016
Filed: July 3, 1969
For: SELF-SUPPORTING HEADSET

Group No. 233

Pet to Make Special
L. C. Clements
1-15-70

San Francisco, California
December 19, 1969

PETITION FOR ADVANCEMENT OF EXAMINATION, RULE 102

The Commissioner of Patents
Washington, D.C. 20231

Sir:

Applicant in the above identified application hereby petitions under Rule 102 to make this application "special" in that it may be advanced for examination.

This petition is supported by a verified showing in the form of the Affidavits of Courtney P. Graham, Chief Executive officer of the corporate assignee of the present application, and Aldo J. Test, attorney in charge of the above entitled pending application.

As shown in Mr. Graham's Affidavit, the assignee's competitor, Roanwell Corporation of New York, has recently announced a Model R-70A Lightweight Telephone Operators' Headset which is an infringement of at least Claims 1, 2, 4, 5 and 6 of the instant

415

286,737	Shepherd	2,566,313	Cates
299,300	Warth	2,586,644	Gilbert
351,209	Seiler	2,596,351	Weaver
835,865	Pieringer	2,717,932	Rackham et al
1,314,819	Lehman	2,780,681	Shaper
1,541,121	Doble	2,904,640	Dreher et al
2,098,402	Reifsteck et al	3,031,537	Rose
2,215,585	Huenlich	3,184,556	Larkin
2,485,405	Olney et al	3,440,365	Bryant et al
2,498,960	Mullin	3,457,376	Kreisel et al

D. A detailed discussion of the above references as concerns the claimed subject matter is set out immediately below.

As reflected in independent Claims 1 and 5, the applicant's invention resides in a headset which may be comfortably mounted behind the ear of a wearer and which is supported solely and stably on the ear. This is achieved by the combination of a curved extension which engages the upper portion of a wearer's ear and a voice tube which extends forwardly from the upper portion of the housing which houses the receiver and microphone towards the mouth. The weight of the voice tube provides a torque which tends to overcome the torque introduced by the weight of the housing and associated components housed therein.

The invention is not disclosed in any one or a combination of the references uncovered in the course of the search. Of the patents uncovered in the search, the most pertinent appears to be the patent to Flagstad et al 3,280,273 which shows a headset mounted behind the ear of the wearer. However, it is noted that the voice tube extends from the bottom of the housing and that the housing is held on the ear of the wearer by the action of the portion 60 of the voice tube which bears against the face of the wearer. Recently issued Bryant et al Patent 3,440,365 shows a telephone headset which is supported solely from the ear by means of an ear insert to which the receiver microphone housing is attached. Larkin Patent

application. If this unlicensed competition is permitted to continue, the assignee will be economically severely injured.

This petition is further submitted in compliance with Section 708.02, M.P.E.P., Petition to Make Special [R-16, 18 October 1968] and is believed to be in accordance with the rules regarding accelerated examination of new applications.

The following is submitted in support of said petition:

A. All the claims present in this application are believed to be directed to a single invention. If it is determined by the Examiner upon grant of the petition that the applicant should be required to elect what the Examiner believes to be one invention from several, the requirement may be made by a telephone communication to applicant's undersigned attorney.

B. A pre-examination search on the claims of this application was made by Bacon and Thomas, patent attorneys, Shoreham Building, Washington, D.C. 20005, pursuant to a request made on October 27, 1969, accompanied with a copy of the application as filed and a copy of Flagstad et al Patent 3,280,273. A copy of the search report is attached hereto as Exhibit 1.

The field of search pertained to the following classes and sub-classes:

Class 179, sub-classes 156 and 187

Class 181, sub-class 22

C. The following references deemed most closely related to the subject matter encompassed by the claims were reported as a result of the search and one copy of each is enclosed:

3,184,556 shows a miniature operator's headset in which the receiver microphone housing is supported adjacent the wearer's ear.

The patent to Rose 3,031,[illegible]37 shows an acoustical device or hearing aid which is mounted behind a wearer's ear. However, it is to be noted that this is not an operator's headset which includes both an acoustical tube extending towards the front to the wearer's mouth and a microphone tube extending into the ear. Each of these references shows only a microphone tube.

Dreher Patent 2,904,640 shows an ear-mounted microphone receiver instrument in which an ear plug serves to hold the instrument.

The remainder of the references cited are not deemed to be applicable to the invention as claimed.

In summary then, it is submitted that Claim 1 is clearly patentable over the references cited in that it calls for a headset having a housing with a microphone and receiver with the housing having an upper curved extension adapted to engage the top of the ear with the voice tube extending from the top of the housing forwardly to the user's mouth and a flexible tube communicating with the receiver and adapted to be inserted in the ear of an operator.

The importance of having a self-supporting headset is apparent. With such a headset, the wearer is completely free to move while carrying on two-way conversation. Such headsets are particularly useful as operators' headsets in the telephone industry but it is contemplated that such headsets will also have great and wide usage by businessmen, executives and the like who wish to use both hands while carrying on telephone conversations. Claims 2, 3 and 4 are dependent on Claim 1 and deemed patentable for the same reasons.

Newly added Claim 5 is similar to Claim 1 but is more specific in calling for the voice tube being provided adjacent said curved extension and more specifically calling for the counter-balancing action of the voice tube for stably holding the headset behind the wearer's ear.

It is believed that the claims in the application are clearly allowable over the art uncovered in the search which, it is believed, was comprehensive. An early action towards allowance of the application is, therefore, respectfully requested.

Respectfully submitted,

FLEHR, HOHBACH, TEST,
ALBRITTON & HERBERT,
Attorneys for Applicant

By ______________________
Aldo J. Test

Telephone: (415) 781-1989

DEC 22 1969

A-24546

MAIL ROOM DEC 22 1969 U.S. PATENT OFFICE

RECEIVED

IN THE UNITED STATES PATENT OFFICE

4 affidavit and Exhibit

In re application of:	)	
KENNETH J. HUTCHINGS	)	Group No. 233
Serial No. 839,016	)	
Filed: July 3, 1969	)	
For: SELF-SUPPORTING HEADSET	)	

L. C. Clemente 1-15-70

A F F I D A V I T

STATE OF CALIFORNIA)
) SS
COUNTY OF SAN MATEO)

ALDO J. TEST, being duly sworn, deposes and states that:

1. He is a partner in the firm of Flehr, Hohbach, Test, Albritton & Herbert.

2. Flehr, Hohbach, Test, Albritton & Herbert represent Pacific Plantronics, Inc. of 111 Josephine Street, Santa Cruz, California, in patent matters.

3. On October 21, 1969, he was called by Courtney Graham, President of Pacific Plantronics, Inc. and asked to meet with him at the San Francisco Airport to examine a Roanwell Corporation bulletin which had been obtained at the United States Independent Telephone Association's (USITA) Convention. Mr. Graham stated that he had been advised by telephone that this Bulletin showed a headset substantially identical to Pacific Plantronics' Model 31A which forms the subject matter of the above entitled application.

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4. I met with Mr. Graham at the San Francisco Airport and examined the Bulletin, Exhibit A of Graham Affidavit.

5. I advised Mr. Graham that the headset appeared to be substantially identical to the Pacific Plantronics, Inc.'s headset shown and claimed in the above entitled pending patent application.

6. I advised Mr. Graham that it was possible under the Rules of the Patent Office to advance examination of the application based upon actual infringement of claims of the pending application.

7. I was then authorized to proceed with the preparation of a petition to make special.

8. I authorized our Washington attorneys to conduct a search to support a petition to make special. I provided them with a copy of the application as filed, a copy of the Roanwell Bulletin and a copy of Flagstad Patent 3,280,273 which was the closest prior art of which I was aware.

9. The results of the search and the reason why the claims of the present application are patentable over the prior art uncovered by our Washington associate are set forth in the accompanying Petition to make special.

10. The headset shown in the inset photograph on the Roanwell Bulletin meets the claims of the pending application as follows:

The Model R-70A headset shows a) a voice tube which extends from the top of the housing and towards the operator's mouth; b) a curved extension which is shown fitted over the top

of the ear of the wearer; c) a receiver tube extending from the bottom of the headset and into the ear canal; and d) an electrical cord associated with the back of the housing and depending downwardly. The headset is supported solely by the action of the voice tube, the curved portion of the housing and weight of the housing and associated cord in substantially the identical manner as set forth in the claims of the pending application.

11. This affidavit is being made in support of the Petition for Advancement of Examination, Rule 102, filed herewith.

Aldo J. Test

Sworn to and subscribed before me this 19 day of December, 1969.

Notary Public

OFFICIAL SEAL [illegible]

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7

ROANWELL CORPORATION

MODEL R-70A LIGHTWEIGHT TELEPHONE OPERATORS' HEADSET

Transducers Meet Telephone Industry Standards of Quality
Behind-the-Ear Design Offers Comfort and Lightness

Model R-70A behind-the-ear telephone operators' headset, designed and manufactured by Roanwell, has wide applications including PBX and other console operations.

The transducers employed in the R-70A are characterized by high resistance to shock, low distortion and lightweight. The adherence of the R-70A transducers to telephone quality standards distinguishes this model from competitive headsets of a similar design.

The R-70A is supplied with five flexible ear inserts of varying sizes. The selection of ear inserts is intended to provide each operator with as comfortable a fit as possible.

Several electronic amplifier options are available, each housed in the R-70A plug assembly. Features include elimination of background noise and gain compensation over a wide range of operating voltage and input signal conditions.

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DEC 22 1969 -5

A-24546

MAIL ROOM DEC 22 1969 U.S. PATENT OFFICE

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In re application of:	)	
KENNETH J. HUTCHINGS	)	Group No. 233
Serial No. 839,016	)	
Filed: July 3, 1969	)	
For: SELF-SUPPORTING HEADSET	)	

A F F I D A V I T

STATE OF CALIFORNIA)
) SS
COUNTY OF SANTA CRUZ)

COURTNEY P. GRAHAM, being duly sworn, deposes and states that:

1. He is President of Pacific Plantronics, Inc., assignee of the above entitled patent application.

2. Pacific Plantronics, Inc. was represented at the recent United States Independent Telephone Association's (USITA) Convention held in Washington, D.C. on October 19-22, 1969.

3. The following employees of Pacific Plantronics, Inc. attended said convention and manned a booth where the company's products were exhibited and explained as required:

Stephen Spragens
Jack Hawkinson
Robert Brown
Murray Macdonald
Jim Wilson

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4. On information and belief, Roanwell Corporation, 180 Varick Street, New York, N.Y. 10014, had a booth at the USITA Convention manned by its personnel where the company's products were exhibited.

5. On information and belief, the employees of Pacific Plantronics visited the Roanwell booth and were handed, among other literature, a bulletin describing the "Model R-70A Lightweight Telephone Operators' Headset", Exhibit A attached hereto.

6. When the Pacific Plantronics, Inc. employees examined the above described Roanwell bulletin, they immediately noted that the headset shown in the inset photograph was substantially identical to Pacific Plantronics, Inc.'s recently ammounced headset Model 81A. The Model 81A is the headset shown and described in the above entitled application for patent.

7. Thereupon Mr. Spragens immediately called me to advise me of this unexpected turn of events.

8. I asked Mr. Spragens to obtain additional copies of the bulletin and to send them to me by special courier.

9. I then called my patent attorney, Aldo J. Test of the firm of Flehr, Hohbach, Test, Albritton & Herbert, to meet me at the San Francisco Airport so that he could examine the bulletin as soon as it arrived in California.

10. My attorney met with me at the Hilton Inn, San Francisco Airport, at 9:00 pm on the evening of October 21, 1969.

11. It was my attorney's opinion that the Roanwell Model R-70A shown in the bulletin, Exhibit A attached hereto, infringed the claims of the above entitled pending patent application.

12. He advised me that under such circumstances the examination of the application could be advanced by petition.

13. I authorized him to proceed with the steps necessary to make the application special.

14. I am of the opinion that continued advertising and sale of the Roanwell Model R-70A will result in substantial injury to Pacific Plantronics, Inc.'s business and its sale of the Lightweight Headset Model 81A, the subject matter of the above entitled application.

15. I am making this affidavit in support of the Petition for Advancement of Examination, Rule 102.

Courtney P. Graham

Subscribed and sworn to before me this 16TH day of December, 1969.

Notary Public

DONA T. MARINOVICH
NOTARY PUBLIC - CALIFORNIA
PRINCIPAL OFFICE IN
SANTA CRUZ COUNTY
MY COMMISSION EXPIRES 8/23/73

COPY

BACON & THOMAS
SHOREHAM BUILDING, 15TH AND H STS., N. W.
WASHINGTON, D. C. 20005

November 19, 1969

Flehr, Hohbach, Test, Albritton & Herbert
Attorneys at Law
160 Sansome Street
San Francisco, California 94104

Attention: Aldo J. Test, Esq.

In re: Patentability Search
HEADSET
Your File Nos. A-24546 & DA-24547
B&T Docket No. 4318

Gentlemen:

As requested in your letter of October 27, 1964, we have conducted a patentability search with regard to the headset construction disclosed in the patent application of Kenneth J. Hutchings. This search was conducted to meet the requirements for a Petition to Make Special.

We have completed our investigation in this matter and as a result the following references were noted:

286,737	Shepherd	2,566,313	Cates
299,300	Warth	2,586,644	Gilbert
351,209	Seiler	2,596,351	Weaver
835,865	Pieringer	2,717,932	Rackham et al
1,314,819	Lehman	2,780,681	Shaper
1,541,121	Doble	2,904,640	Dreher et al
2,098,402	Reifsteck et al	3,031,537	Rose
2,215,585	Huenlich	3,184,556	Larkin
2,485,405	Olney et al	3,440,365	Bryant et al
2,498,960	Mullin	3,457,376	Kreisel et al

We have made a comprehensive collection of the prior art pertinent to this device. A number of the selected references disclose headsets provided with a voice tube adapted to

Exhibit 1

carry sound from the vicinity of the user's mouth to the headset positioned behind the ear. The remaining references relate to various other arrangements of sound conducting tubes associated with headsets and the like.

Our search included Class 179, subclasses 156 and 187; and Class 181, subclass 22.

Enclosed are copies of the selected references, together with your descriptive material.

Very truly yours,

BACON & THOMAS

TFR:dc
Enclosures

475

No. 835,865.

PATENTED NOV. 13, 1906.

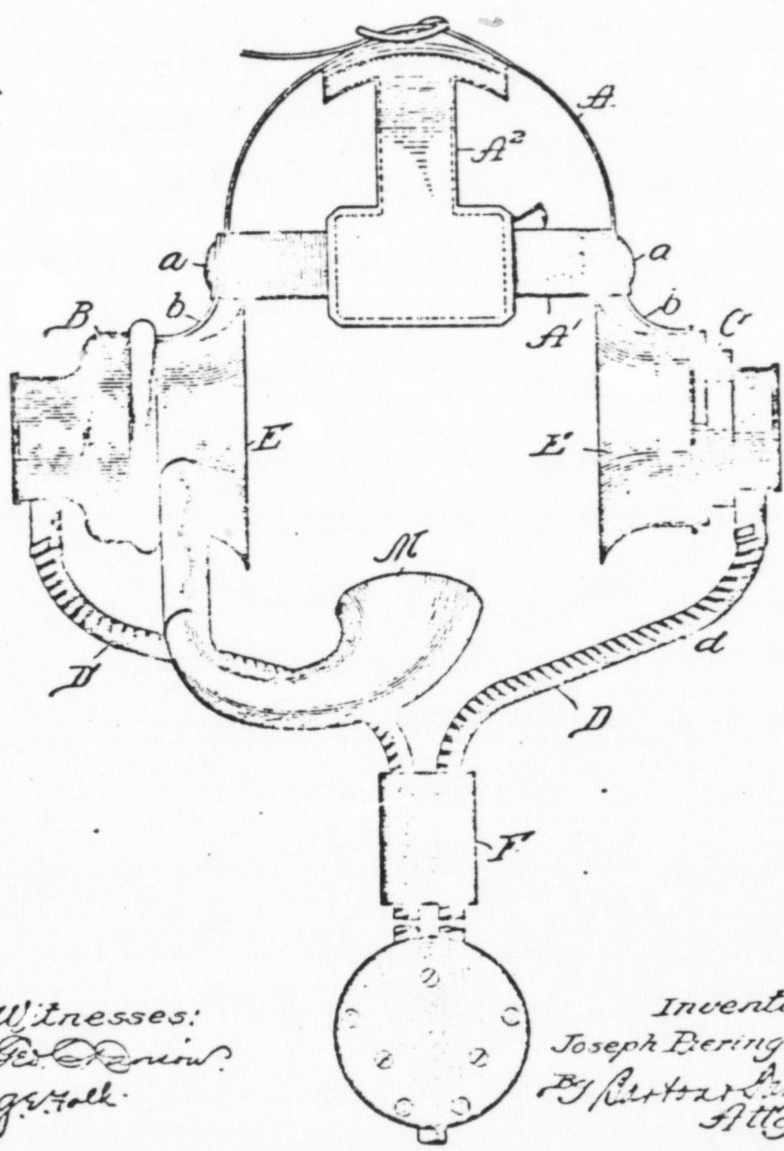
J. PIERINGER.

HEAD TELEPHONE SET.

APPLICATION FILED DEC. 1, 1905.

2 SHEETS—SHEET 1.

Fig 1



Witnesses:

Geo. Barrow

G. E. Folk

Inventor:

Joseph Pieringer.

By Richards & Co.

Attys.

429

No. 835,865. PATENTED NOV. 13, 1906.

J. PIERINGER.

HEAD TELEPHONE SET.

APPLICATION FILED DEC. 1, 1905.

2 SHEETS—SHEET 2.

Fig 2.

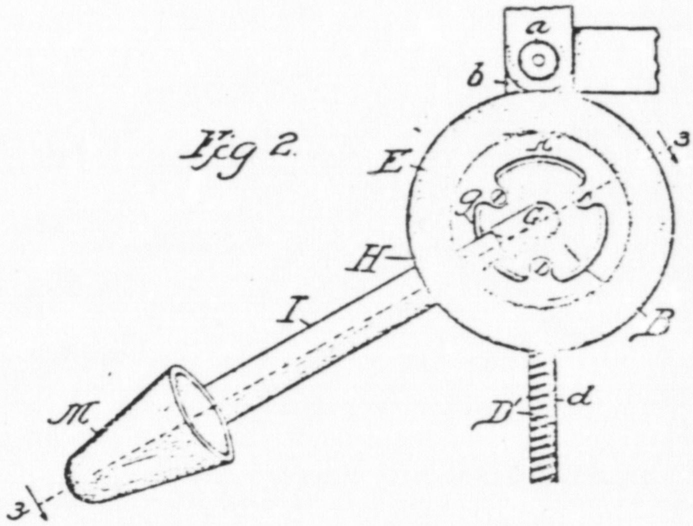
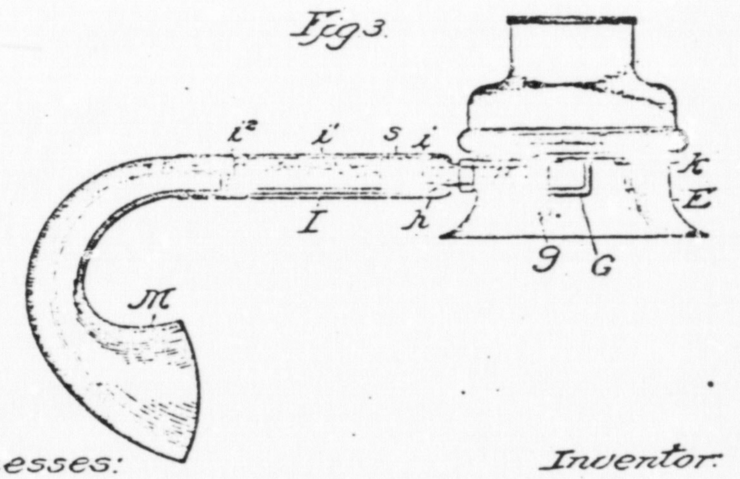


Fig 3.



Witnesses:

Geo. C. [illegible]

G. E. Folk.

Inventor:

Joseph Pieringer,

By [illegible]

Attys.

UNITED STATES PATENT OFFICE.

JOSEPH PIERINGER, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

HEAD TELEPHONE SET.

No. 835,865. Specification of Letters Patent. Patented Nov. 13, 1906.

Application filed December 1, 1905. Serial No. [illegible].

To all whom it may concern:

Be it known that I, JOSEPH PIERINGER, a citizen of the United States, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented a certain new and useful Improvement in Head Telephone Sets, of which the following is a full, clear, concise, and exact description.

My invention relates to a head telephone set, and has for its object an arrangement of the transmitter and receiver on a harness adapted to fit over the head of the user in such manner that the weight of the transmitter and receiver will balance each other and the various parts will be conveniently assembled for use.

My invention is especially adapted for use on man-of-war vessels, in which case it is necessary or at least desirable to have the receiver held constantly to the ear of the user. In my invention the transmitter and receiver are supported by a head-harness in such positions that the receiver is held over one ear and the transmitter over the other, thus producing an almost perfect balance of weight. The mouthpiece is adjustably mounted with reference to the transmitter. Ear-caps may be secured to both the receiver and transmitter, thus providing for the comfort of the user, as well as excluding outside noises. Means are also provided for securely holding the apparatus in proper position.

My invention may be readily understood from the accompanying drawings, in which—

Figure 1 is a front elevation of the apparatus constituting my invention. Fig. 2 is a detail view of the transmitter. Fig. 3 is a section on the line 3 3 of Fig. 2.

The harness preferably consists of two straps A A', adapted to fit over the top and back, respectively, of the head, and a stiff band A², serving to hold said straps properly spaced apart. The ends of the straps A A' are connected to each other by rivets *a*. The harness is made adjustable in size by buckles, as shown in the drawings.

The transmitter B and the receiver C have each a lug *b* extending from its shell or casing. An opening is provided in each lug for the reception of a rivet *a*, by which means the two instruments are secured to the harness on opposite sides thereof. Binding-posts, to which the terminals of the cords D D' are attached, are placed within the shells of the transmitter and receiver in the usual manner. Ear-caps E E, preferably of soft rubber, extend from each instrument and are adapted to completely surround the ears of the user, so as to exclude outside noises and also to prevent said instruments from uncomfortably bearing against the head of the user. These ear-caps may be secured to the two instruments in any suitable way.

I have shown in Figs. 2 and 3 a convenient means for attaching the cap to the transmitter, in which an annular plate *k*, secured by screws to the base of the transmitter, serves to clamp the cap E between said plate and base.

A slip-block F passes over cords D and D', by which means the cords may be drawn close under the chin. The cords D D' are made stiff by a metallic winding *d* or in any other suitable manner, so that when the cords are drawn under the chin the instruments are pressed directly toward the ears and the throat is left free. This is a distinct advantage, since a cord not so stiffened would when drawn under the chin bear against the throat in such manner as to be uncomfortable to the user and would also interfere with his articulation.

The mouthpiece M of the transmitter is made adjustable with reference to the shell or casing, so as to be readily placed in any desired position by the user. This is most clearly shown in Fig. 3. The inner wall of the casing of the transmitter has an opening through an elbow G provided with a screw-threaded outlet *g*. Threaded in this outlet is a hollow tube H, which extends through the ear-cap E and has a spherical head *h*, whereby a ball-and-socket connection is provided between the tube H and a tube I. A washer *i* fits over the end of the head *h*, and one end of a coiled spring *s* bears against said washer, the other end of said spring bearing against the inner end of a wooden tube *i'*, inclosed within the tube I. A nut *i²*, threaded in the tube I a short distance from its outer end, serves to hold the tube *i'* in position against the tension of the spring *s*. The mouthpiece M is secured in the end of the tube I above the nut *i²*.

By the construction above described it is apparent that the mouthpiece of the trans-

mitter is readily adjustable with reference to the transmitter and that the tension of the spring *s* produces sufficient frictional engagement in the ball-and-socket joint of the tube H and I to hold the mouthpiece in its adjusted position.

I claim—

1. The combination with harness for a head telephone set, of a receiver and a transmitter mounted on opposite sides of said harness and adapted to fit over the ears of the user, a tubular member having one end secured to the communicating orifice of said transmitter and provided at its other end with a spherical head, a second tubular member provided with a mouthpiece and inclosing said head to form a ball-and-socket joint therewith, whereby said members are adjustable, and means for holding said members in their adjusted positions, substantially as described.

2. The combination with harness for a head telephone set, of a receiver and a transmitter mounted on opposite sides of said harness and adapted to fit over the ears of the user, a tubular member having one end secured to the communicating orifice of said transmitter and provided at its other end with a spherical head, of a second tubular member inclosing said head and forming a ball-and-socket joint therewith, a wooden tube inclosed in said second tubular member, a nut for holding the wooden tube in position, a coiled spring bearing against said wooden tube and said spherical head, whereby said ball and socket are held in their adjusted positions, and a mouthpiece carried by said second tubular member, substantially as described.

In witness whereof I hereunto subscribe my name this 5th day of September, A. D. 1905.

JOSEPH PIERINGER.

Witnesses:
A. W. OSBORN,
GEORGE F. ATWOOD.

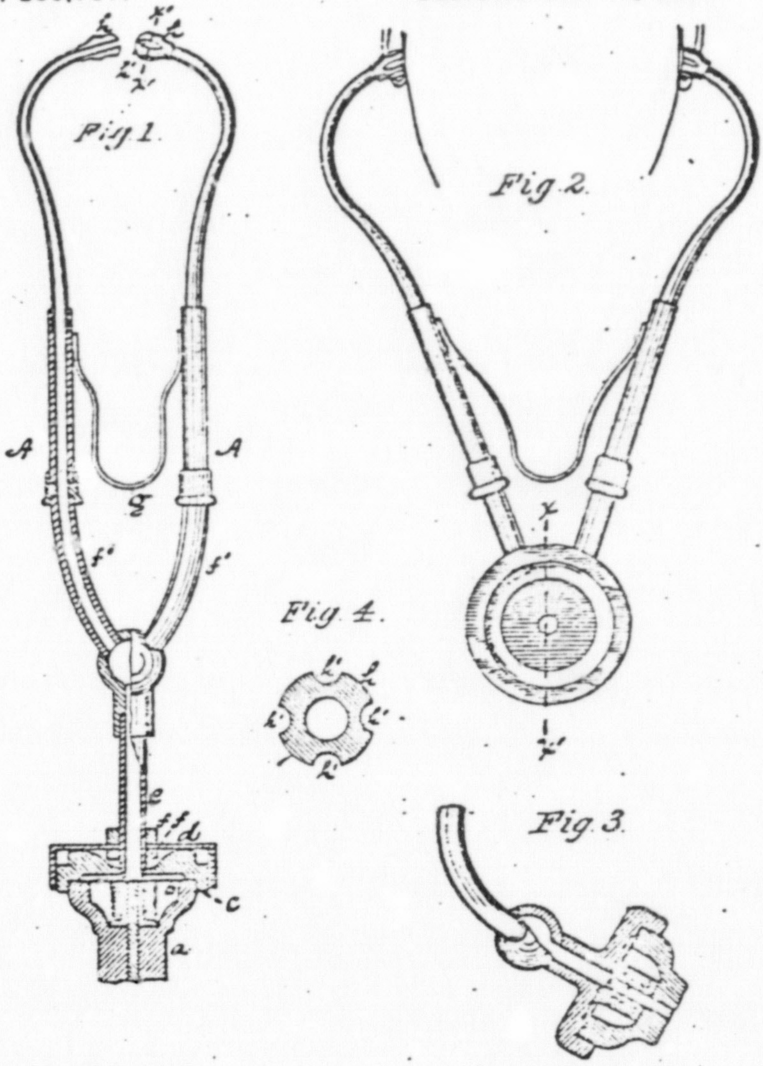
D — C

(No Model.)

G. R. SHEPHERD.

TELEPHONE.

No. 286,737. Patented Oct. 16, 1883.



Witnesses:
Chas. L. Burdett.
James J. Greene.

Inventor.
George R. Shepherd
By W. E. Simonds
Atty

UNITED STATES PATENT OFFICE.

GEORGE R. SHEPHERD, OF HARTFORD, ASSIGNOR OF ONE HALF TO WILLIAM EDGAR SIMONDS, OF CANTON, CONNECTICUT.

TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 286,737, dated October 16, 1883.

Application filed March 26, 1881. (No model.)

To all whom it may concern:

Be it known that I, GEORGE R. SHEPHERD, of Hartford, in the county of Hartford and State of Connecticut, have invented a certain new and useful Improvement in Telephones, of which the following is a description, reference being had to the accompanying drawings, where—

Figure 1 is a side view, partly in central vertical section, of an apparatus embodying my said improvement. Fig. 2 is a view of an apparatus, substantially the same as represented in Fig. 1, applied to a person's ears. The flexible tubes are bent so that the bottom or under side of the telephone proper is turned toward the observer. Fig. 3 is a view of the telephone represented in Fig. 2 in section on the plane *x x*. The telephone shown in Figs. 2 and 3 is modified somewhat from the telephone shown in Fig. 1. Fig. 4 is an enlarged view, in cross section, on the plane *x' x'* of one of the ear pads.

My improvement is an attachment for any of the common forms of telephone, particularly useful where a telephone is located in a noisy room, or at the end of a long line, where the sound producing impulse becomes weak, or where the user's hearing is slightly defective. The telephone itself—by which I mean that part of telephone apparatus which receives and communicates to the listener the sounds transmitted to it—forms no part of my invention.

The invention consists, speaking generally, of the combination of a telephone, a sound-gathering cap suitably attached to the telephone, and a bifurcated tube leading therefrom for conveying the sounds to both ears when these bifurcated tubes are so joined and connected that they may be grasped and adjusted to the listener's ears by the use of only one hand.

The invention further consists in details for carrying out this idea.

The letter *a* denotes the body of a telephone, *b* the vibrating diaphragm which reproduces the transmitted sounds, and *c* an end plate which secures the diaphragm in place.

The letter *d* denotes a cap which may be attached to the periphery of the end plate, *c*, by spring pressure, by screwing thereon, by clamps, or in any other convenient manner. The means intended to be represented in the drawings is an elastic lining of soft rubber within the cap *d*. This cap *d* is perforated axially for the passage of the tube *e*, which runs down almost to contact with the diaphragm *b*. Tube *e* is exteriorly screw threaded and provided with the nuts *f f*, by means of which the position of the tube with reference to the diaphragm may be adjusted to a nicety. At the upper end this tube *e* bifurcates, giving one tube for each ear.

The apparatus will work reasonably well if the two branching tubes are stiff or rigid, there being in such case a pivotal joint at the point of bifurcation, and a suitable connection between the two branches, enabling them to be handled and adjusted to the ears by one hand of the user; but it is better that a part, *f*, of each of these tubes be flexible, obviating the use of a pivot joint at the point of bifurcation, and allowing the tubes to bend, and thereby adapt themselves to different positions more readily. The upper part of the two branching tubes may be of hard rubber or metal. The two tubes are connected by spring *g*, which acts in the capacity of a pivot as well as a spring, tending to close the tubes together. A separate pivot-connection may be used, but I prefer the spring, serving both purposes. If the two tubes be grasped in one hand, at about the height A, and pressed together, the ends of the tubes will move apart, as represented in Fig. 2, and the tubes may be applied to both ears by one hand of the user. The ends of the tubes, which come in contact with the ears, are furnished with pads *h* of suitable material—soft rubber, for instance—and are peripherally fluted by flutes *h'*, to permit access of the exterior air.

In Fig. 3 (and Fig. 2 is a different view of same) I show the tube *e* made integral with the end plate of the telephone.

I claim as my improvement—

The combination of the telephone, the sound-gathering cap suitably attached thereto, the bifurcated tube, and the pivotal connection joining the bifurcations, all substantially as described, and for the purpose set forth.

GEORGE R. SHEPHERD

Witnesses:

W. E. SIMONDS,
CHARLES L. BURDETT.

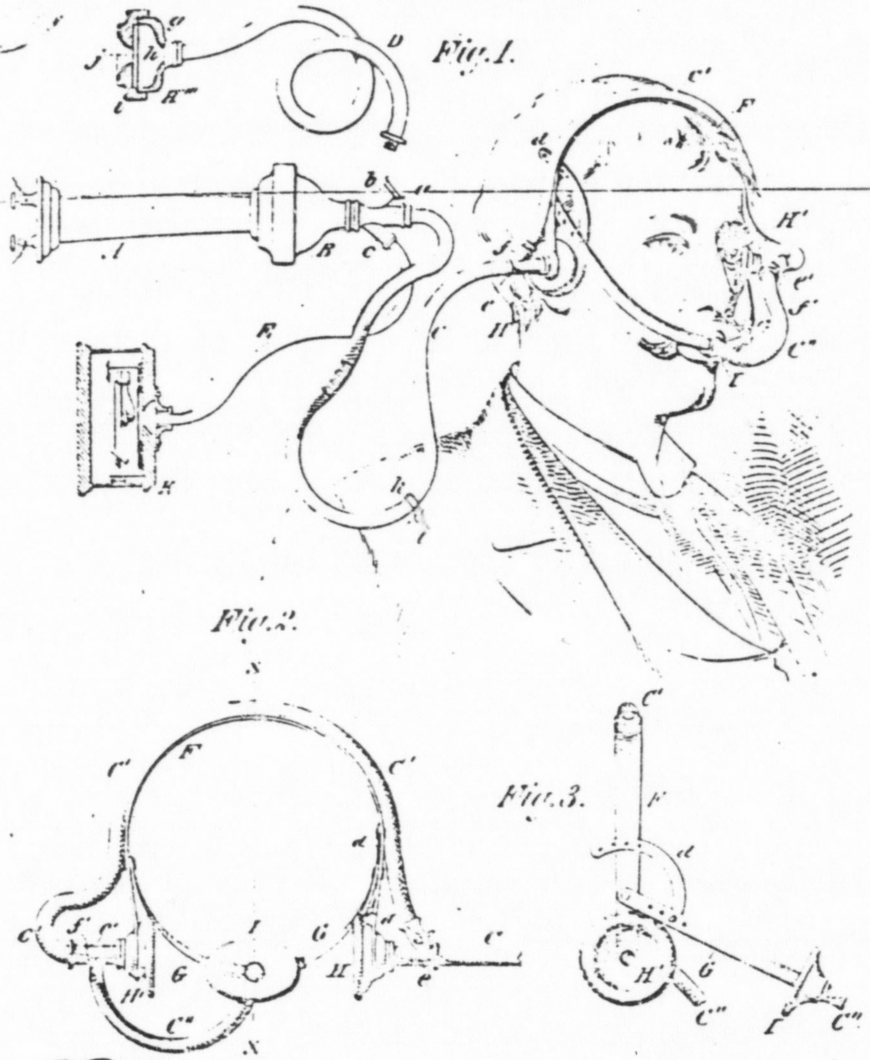
434

(No Model.)

N. G. WARTH.

TELEPHONE SUPPORT.

No. 299,300. Patented May 27, 1884.



WITNESSES:

Gustave Dieterich

C. Sedgwick

INVENTOR:

N. G. Warth

BY Munn & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

NATHANIEL G. WARTH, OF CANTON, OHIO.

TELEPHONE-SUPPORT.

SPECIFICATION forming part of Letters Patent No. 299,300, dated May 27, 1884.

Application filed February 13, 1884. (No model.)

To all whom it may concern:

Be it known that I, NATHANIEL G. WARTH, of Canton, Stark county, Ohio, have invented a new and Improved Telephone-Support, of which the following is a full, clear, and exact description.

My invention relates to improvements in telephone-supports; and it consists in ear-pieces and a mouth-piece attached to an adjustable frame, and connected with each other and with the receiving and transmitting telephones by flexible tubes, the object being to enable a central-office operator to listen and converse while the hands are left free to manipulate the switch-board.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a perspective view, partly in section, of the apparatus, showing the manner in which it is applied. Fig. 2 is a detail view of the head-piece, and Fig. 3 is a vertical transverse section taken on the line *x x* in Fig. 2.

The receiving-telephone A, of ordinary well-known construction, is supported in a fixed position, and is provided with a mouth-piece extension, B, having three branch tubes, *a b c*, for receiving flexible tubes C D E. A curved spring, F, of approximately semicircular form, is jointed to a similar spring, G, and these two springs are maintained in a fixed position in relation to each other by the curved brace *d*, which is made adjustable by having several holes, through any one of which a screw may be inserted in the spring F. At the end of the spring G there are several holes for receiving a screw which enters the end of the brace *d*. This provision for adjustment is required to adapt the apparatus to the heads of different users.

Attached to the ends of the curved spring F are ear-pieces H H', provided, respectively, with tubes *e e'*, having branches *f f'*. The tube *e* of the ear-piece H communicates by means of the flexible tube C with the central tube, *a*, of the extension B on the receiving-telephone, and a tube, C', connected with the branch *f*, communicates with the tube *e'* of the ear-piece H', and the branch *f'* of the said tube communicates by means of the flexible tube C'' with a mouth-piece, I, secured to the center of the spring G. By means of this arrangement of the curved springs F G, the ear-pieces and the mouth-piece are held in position for use. The branch *c* of the extension B is connected by a flexible tube, E, with the telephone-transmitter K. An ear-piece, H''', similar to the ear-pieces H H', is provided with a flexible tube, D, by which it may be connected with a branch, *b*, of the extension B, to enable a second person to listen. The ear-piece consists of a diaphragm-cell, *g*, having a resonant chamber, *h*, and a chambered cap, *i*, provided with a small central orifice for the escape of sound.

In the cell *g* is mounted a diaphragm, *j*, made of a very thin plate of mica or other similar material, and capable of being moved by the vibrations of the air in the flexible tubes, the air itself being vibrated by the movement of the diaphragm in the receiver A.

Sounds produced by the receiver-diaphragm are communicated to the ear through the extension B, tubes C C', and the ear-pieces H H', and speech uttered in the mouth-piece I affects not only the transmitter through the pipes C'', C', C, and E, but also the receiver, which thus acts as a transmitter also, and augments the volume of sound transmitted. Should the impulses transmitted through the tubes be so violent as to affect the transmitter unfavorably, the tube D may be removed from the branch *b*, allowing a part of the sound to escape through the branch.

To prevent any accidental jerking of the apparatus from the head of the user, I have placed a ring, *k*, on the flexible pipe C, and provided a hook or clasp-pin, *l*, by which the tube may be attached to the clothing at the shoulder. The flexible tube is formed upon or within a wire spiral to prevent kinking.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with the receiving-telephone A, of two ear-pieces, H H', the curved spring F, for holding the said ear-pieces to the ears, and the tubes C C', connecting the ear-pieces and receiver, as described.

2. The combination of the ear-pieces H H' and mouth-piece I with the frame composed of the curved springs F G and brace *d*, as described.

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3. The combination, with the receiving-telephone A and transmitting-telephone K, of the ear-pieces H H', mouth-piece I, and the connecting-tubes C, C', C'', and E, as described.

4. The combination, with the receiving-telephone A, provided with the extension E, having branches a b c, and the transmitting-telephone K, of the ear-pieces H H' H''', the ear-piece H''' being provided with the diaphragm the mouth-piece I, and the connecting-tubes [illegible] E, substantially as herein shown and described.

NATHANIEL G. WARTH.

Witnesses:
JOHN S. LOWE, [L. S.]
IRA W. FISHER. [L. S.]

#5

U.S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON, D.C. 20231

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THE COMMISSIONER OF PATENTS
WASHINGTON, D.C. 20231

JAN 21 1970

Ex parte Kenneth J. Hutchings	:	
Serial No. 839,016	:	On Petition To Make Special
Filed July 3, 1969	:	
Self-Supporting Headset	:	

The applicant petitions that the above identified application be made special.

The apparent ground for the petition is infringement. The petition, however, is not supported by a showing satisfying the several specific requirements set forth in Section II of the enclosed circular. In this connection attention is directed to the fact that the affidavit filed by applicant's attorney does not state that he has made a rigid comparison of the actual alleged infringing device as distinguished from a brochure advertising the same with the claims of the application.

The petition is accordingly denied.

Richard A. Wahl
Richard A. Wahl
Assistant Commissioner

Flehr, Hohbach, Test, Albritton and Herbert
15th Floor, Hongkong Bank Building
160 Sansome Street
San Francisco, California 94104

438

#10

-24546

MAIL ROOM FEB 2 1970 U.S. PATENT OFFICE

6

Suppl. To Pet
I.C. Clements
2-27-70

IN THE UNITED STATES PATENT OFFICE

In re application of:	)	
KENNETH J. HUTCHINGS	)	Group No. 233
Serial No. 839,016	)	Richard A. Wahl, Assistant Commissioner
Filed: July 3, 1969	)	
For: SELF-SUPPORTING HEADSET	)	

San Francisco, California

January 29, 1970

SUPPLEMENT TO

PETITION FOR ADVANCEMENT

OF EXAMINATION, RULE 102

The Commissioner of Patents
Washington, D.C. 20231

Sir:

On January 21, 1970, the Assistant Commissioner issued a decision on applicant's Petition to make "special" filed on or about December 20, 1969.

In said decision the Assistant Commissioner denied applicant's petition stating that it failed to satisfy the requirements set forth in the guidelines dated July 1968 entitled "Petitions to Make Applications Special", and more particularly Section II thereof.

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Applicant's attorney did make a comparison of a photograph of the alleged infringing device with the claims of the application. This comparison was sufficient to show that the device being offered by the competitor was in fact an infringement of the claims presented for consideration.

Furthermore, the Petition as submitted clearly complied with Section VI of the circular entitled "SPECIAL EXAMINING PROCEDURE FOR CERTAIN NEW APPLICATIONS - ABBREVIATED AND ACCELERATED EXAMINATION" in all respects.

It is, therefore, respectfully requested that the decision be reconsidered as to Section II, infringement, and that the Petition be considered in the first instance with regard to Section VI.

Respectfully submitted,

FLEHR, HOHBACH, TEST,
ALBRITTON & HERBERT,
Attorneys for Applicant

By ____________________
Aldo J. Test

Telephone: (415) 781-1989

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Paper No. 7

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D.C. 20231

U.S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON, D.C. 20231

APR 1 1970

MAILED

APR 1 1970

GROUP 230

Ex parte Kenneth J. Hutchings :
Serial No. 839,016 :
Filed July 3, 1969 : On Petition
For: Self-Supporting Headset :

Applicant requests that the Petition filed Dec. 22, 1969 and denied by the Assistant Commissioner in a decision rendered Jan. 21, 1970 be reconsidered under Section VI of the circular enclosed with that decision.

The petition as submitted does comply with the requirements of Section VI (M.P.E.P. 708.02) of the circular and applicant is therefore entitled to the special status provided for by that section.

The petition is granted to the extent indicated above.

JFC:cms

John F. Couch
John F. Couch
Director
Examining Group 230

Flehr, Hohback, Test, Albritton and Herbert
15th Floor, Hongkong Bank Bldg.
160 Sansome St.
San Francisco, Calif. 94104

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U.S. DEPARTMENT OF COMMERCE
Patent Office

Address Only: COMMISSIONER OF PATENTS
Washington, D.C. 20231

In Reply Please Refer To The Following:		
EXAMINER'S NAME William C Cooper		
232	July 3,1969	839,016
GR. ART UNIT	FILING DATE	SERIAL NO.
Kenneth J. Hutchings		
APPLICANT		INVENTION
SELF-SUPPORTING HEADSET		

Paper No. 8

Mailed

Flehr, Hobach, Test, Albritton and
Herbert; 15th Floor
Hongkong Bank Building; 160 Sansome St.
San Francisco, Calif. 94104

This is a communication from the Examiner in charge of your application.

Commissioner of Patents

[X] This application has been examined.

[ ] Responsive to communication filed ______

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS ACTION IS SET TO EXPIRE THREE MONTHS ____ DAYS FROM THE DATE OF THIS LETTER.

The following attachment(s) are part of this action:

a. [X] Notice of References Cited, PO-892.
b. [ ] Notice of Informal Patent Drawing, PO-948.
c. [ ] Notice of Informal Patent Application, PO-152.
d. [ ]

Summary of Action

1. [X] Claims 1 - 6 are presented for examination.
2. [ ] Claims ______ are allowed.
3. [ ] Claims ______ would be allowable if amended as indicated.
4. [X] Claims 1 - 5 are rejected.
5. [ ] Claims ______ are objected to.
6. [ ] Claims ______ are subject to restriction or election requirement.
7. [ ] Claims ______ are withdrawn from consideration.
8. [ ] Since this application appears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.
9. [ ] Since it appears that a discussion with applicant's representative may result in agreements whereby the application may be placed in condition for allowance, the examiner will telephone the representative within about 2 weeks from the date of this letter.
10. [ ] This action is made final.

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11. Claims 1 and 2 are rejected under 35 U.S.C. 103 as unpatentable over Flygstad. Insofar as these claims are concerned, it is considered a mere matter of [illegible]e whether the microphone is at the top or bottom of the unit, with the receiver occupying the other position. The receiver tube of Flygstad constitutes an "upper curved extension" of the housing.

12. Claims 3 and 4 are rejected under 35 U.S.C. 103 as unpatentable over Flygstad in view of Bryant et al. Bryant's device is used for exactly the same purpose as either Flygstad or applicant's device and it would be obvious to apply the voice tube of Bryant with it's ball joint and extension features to the device of Flygstad.

13. The subject matter of claims 5 and 6 appears to have patentable significance; however the claims as written are rejected as vague and indefinite under 35 U.S.C. 112. Applicant's attention is directed to the dictionary definition of "pivot". It is not seen that the "curved extension" can act as a pivot. If anything, the extension pivots on the top of the ear, although this is not strictly accurate, since because both

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surfaces are curved, there will be a rolling motion between them, not a pivoting action. Claims should be drawn which more accurately define the construction.

W. C. Cooper:sm

Area Code 703
557-2118

William C Cooper

WILLIAM C. COOPER
EXAMINER
GROUP ART UNIT 232

444

TO [illegible]ATE, HOLD TOP AND BOTTOM EDGES, SNAP-AP[illegible]ISCARD CARBON

ATTACHMENT TO PAPER NO.

FORM PO-892 (7-69)

U.S. DEPARTMENT OF COMMERCE
PATENT OFFICE

NOTICE OF REFERENCES CITED

☐ Check here if this is a supplemental citation (Do not prepare an additional folder)

SERIAL NO. 839,016

GROUP ART UNIT 232

APPLICANT(S) HUTCHINGS

U.S. PATENTS

	PATENT NO.	DATE	PATENTEE	CLASS	SUB-CLASS	FILING DATE IF APPROPRIATE
1	2904640	9/1959	Dreher et al	179	156	
2	3184556	5/1965	Larkin	179	156	
3	3280273	10/1966	Flygstad	179	156	
4	3440365	4/1969	Bryant et al	179	156	
5	3457376	7/1969	Kreisel et al	179	156	~~11/1965~~
6						
7						
8						
9						
10						
11						

FOREIGN PATENTS OR PUBLISHED APPLICATIONS

	PATENT NO.	DATE	COUNTRY	NAME	CLASS	SUB-CLASS	PERTINENT SHTS. DWG.	PERTINENT PP. SPEC.
1								
2								
3								
4								
5								
6								

OTHER REFERENCES (Include author, title, date, pertinent pages, etc.)

EXAMINER W C Cooper

DATE 5-11-70

☐ Check here if continued on back page

445

JUL 1 1970 15

A-24546

JUL 1 1970
U.S. PATENT OFFICE

RECEIVED
JUL 9 1970

9/B

IN THE UNITED STATES PATENT OFFICE

In re application of:	)	
KENNETH J. HUTCHINGS	)	Group No. 232
Serial No. 839,016	)	Paper No. 9
Filed: July 3, 1969	)	Examiner William C. Cooper
For: SELF-SUPPORTING HEADSET	)	

San Francisco, California
June 29, 1970

A M E N D M E N T

The Commissioner of Patents
Washington, D.C. 20231

Sir:

This amendment is responsive to the Office Action dated May 13, 1970. Amendment is requested to be made as follows:

IN THE CLAIMS

1. ~~(amended)~~ A headset comprising a housing adapted to be placed behind the ear of a user, said housing [and] including an integral upper curved extension adapted to extend over and engage the top of the ear, a microphone disposed in and near the top of said housing, a forwardly extending voice tube communicating with said microphone and positionably secured to the upper [portion] extension of said housing, said voice tube being adapted to have its distal end positioned adjacent the user's mouth, a receiver disposed in and near the bottom of said housing,

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3 and a flexible tube secured to the bottom of the housing and adapted to provide communication to the auditory canal of the user's ear.

5. ~~(amended)~~ A headset comprising a housing, a microphone and a receiver disposed in said housing, said housing being shaped to fit behind the ear of a user, said housing including an upper curved extension adapted to extend over and engage the top of the ear, a forwardly extending voice tube secured to the upper portion of the housing adjacent said curved extension with its distal end adapted to be positioned adjacent the wearer's mouth, said curved extension [acting as a pivot] bearing on the ear whereby the weight of the voice tube provides a torque which counteracts the torque introduced by the weight of the housing to balance the headset and securely hold the same on a wearer's ear.

B2

Add new Claim 7:

7. A headset as in Claim 5 including a flexible tube secured to the bottom of the housing and adapted to provide communication between the auditory canal of the user and the receiver.

B3

447

REMARKS

Claims 1 and 5 which were indicated as being allowable have been amended to overcome the indefiniteness pointed out by the Examiner. Claim 1 has been revised to more clearly bring out applicant's invention. Claim 7, dependent upon allowable Claim 5, has been added.

The Examiner is thanked for the courtesies extended to applicant's attorney on June 19, 1970. During the interview the Examiner suggested wording for Claim 5 to overcome the rejection under 35 U.S.C. 112. Applicant indicated changes proposed with regard to Claim 1 and it was agreed that when so amended Claim 1 would be allowable.

In essence, the claims define a headset which is entirely different from the prior art headset in that the particular arrangement of the voice tube and housing permit the headset to be stably balanced on the ear of a user.

Favorable action is respectfully requested.

Respectfully submitted,

FLEHR, HOHBACH, TEST,
ALBRITTON & HERBERT,
Attorneys for Applicant

By ______________________
Aldo J. Test

Telephone: (415) 781-1989

448

JUL 1 1970

JUL 1 1970
U.S. PATENT OFFICE

Jan 7 #9

IN THE UNITED STATES PATENT OFFICE

RECEIVED
JUL 9 1970
GROUP 230

In re application of:)
KENNETH J. HUTCHINGS)
Serial No. 839,016)
Filed: July 3, 1969)
For: SELF-SUPPORTING HEADSET)

Group No. 232

Examiner William C. Cooper

San Francisco, California
Date: June 29, 1970

The Commissioner of Patents
Washington, D. C. 20231

Sir:

Transmitted herewith is an amendment in the above-identified application.

XXX No additional fee is required.

The fee has been calculated as shown below.

Claims as amended

(1)	(2) Claims remaining after amendment	(3)	(4) Highest number previously paid for		(5) Present extra		(6) Rate	(7) Additional fee
Total claims	* 7	Minus	** 10	=	0	x	$2	= 0
Independent claims	* 2	Minus	2	=	0	x	$10	= 0
			Total additional fee for this amendment					0

* If the entry in Column 2 is less than the entry in Column 4, write "0" in Column 5.

** If the "Highest Number Previously Paid For" in this space is less than 10, write "10" in this space.

☐ A check in the amount of $________ is enclosed.

☐ Please charge any additional fees or credit overpayment to Deposit Account No. 06-1300. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

FLEHR, HOHBACH, TEST, ALBRITTON & HERBERT

By ____________________

Telephone: (415) 781-1989

449

POL-85
(REV. 12/69)

All communications regarding this application should give the serial number, date of filing, and name of the applicant.

U.S. DEPARTMENT OF COMMERCE
Patent Office

Address Only: COMMISSIONER OF PATENTS
Washington, D.C. 20231

NOTICE OF ALLOWANCE AND BASE ISSUE FEE DUE

The application identified below has been examined and found allowable for issuance of Letters Patent.

	FILING DATE	SERIAL NO.	NO. OF CLAIMS ALLOWED	EXAMINER AND GROUP ART UNIT
	07/03/69	839016	7	Cooper 232
APPLICANT	Hutchings, Kenneth J.; Soquel, Calif.			MAILED July 22, 1970 smc
TITLE OF INVENTION (X indicates as amended by examiner)	Self-supporting headset			88
	BASE FEE COMPUTATION		BASE FEE DUE	CLASS-SUB
$100.00	+ $4 (FOR DWG. @ $2 PER SHEET)	+ $10 (FOR FIRST PAGE PRINTED SPEC.)	$114	179/156.

The complete Issue Fee is one hundred dollars ($100) plus two dollars ($2) for each sheet of drawing, plus ten dollars ($10) for each printed page of specification (including claims) or portion thereof.

Inasmuch as the final number of printed pages cannot be determined in advance of printing, an initial BASE ISSUE FEE (consisting of the fee for printing the first page of specification ($10) plus the fee of ($2) for each sheet of drawing, added to the fee of $100) *must be paid within three months from the date of this notice*, or the application shall be regarded as ABANDONED.

When remitting said Base Issue Fee, enclosed Form POL-85b should be used, and if use of a Deposit Account is being authorized, POL-85c should also be forwarded.

The Base Issue Fee will not be accepted from anyone other than the applicant, his assignee, attorney, or a party in interest as shown by the records of the Patent Office.

If an assignment has not been previously filed and it is desired to have the patent issue to the assignee, the assignment must be received in this Office with the recording fee together with the Base Issue Fee. In any event the space for "Assignee" on the POL-85b must be appropriately completed. Where the assignment is to a corporation, the city and state of the corporation as well as the state of incorporation must also be given, to ensure inclusion in the heading of the printed patent.

In connection with the address of the inventor(s), attention is directed to Form POL-231 enclosed.

A Notice of Balance of Issue Fee Due will be mailed together with the patentee's copy of the patent *if an additional fee is due*. Payment must be made within three months from the date shown on said Notice since FAILURE TO PAY THIS BALANCE WITHIN THE TIME SPECIFIED WILL RESULT IN LAPSE OF THE PATENT.

Flehr, Hohbach, et al
15th Floor, Hongkong Bank Bldg.
160 Sansome Street
San Francisco, Calif. 94104

PATENT OFFICE COPY

POL-85b
(REV. 12/69)

AUG 1970 -15

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PATENT OFFICE

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10° 4°

U.S. Department of Commerce
Patent Office

BASE ISSUE FEE TRANSMITTAL

This form is provided in lieu of a formal transmittal and should be used for transmitting the Base Issue Fee. Items numbered 1 through 4 below should be completed as appropriate. The Base Issue Fee Receipt will be mailed to the address appearing in item 4 or as designated in item 4a below.

1. THE COMMISSIONER OF PATENTS is requested to apply the Base Issue Fee to the application identified below and deliver the patent as indicated.

FLEHR, HOHBACH, TEST, ALBRITTON & HERBERT

August 3, 1970
Date

By: Aldo J. Test
(SIGNATURE OF PARTY OF INTEREST OF RECORD)

NOTE: The Base Issue Fee will not be accepted from anyone other than the applicant, his assignee, or attorney, or a party in interest as shown by the records of the Patent Office, nor will this fee be accepted in the application prior to the Notice of Allowance.

	FILING DATE	SERIAL NO.	NO. OF CLAIMS ALLOWED	EXAMINER AND GROUP ART UNIT
	07/03/69	839016	7	Cooper 232
APPLICANT	Hutchings, Kenneth J., Soquel, Calif.			MAILED July 22, 1970 amc
TITLE OF INVENTION (X indicates as amended by examiner)	Self-supporting headset			NOTICE OF ALLOWANCE DATE

BASE FEE COMPUTATION					BASE FEE DUE	CLASS-SUB
$100.00	+ $4	(FOR DWG. @ $2 PER SHEET)	+ $10	(FOR FIRST PAGE PRINTED SPEC.)	$114	179/156.

AUG-18-70

2. ASSIGNEE (Item a or item b below MUST BE COMPLETED (Rule 334))

a. ☐ NONE

b. ☒ YES. Assignment is to PACIFIC PLANTRONICS, INC.

(1) ☐ Assignment herewith.

(2) ☒ The Patent Office has recorded and returned the assignment which is as shown in "b" above.

☒ YES ☐ NO

3. BASE FEE ENCLOSED

☒ YES ☐ NO

Charge to my Deposit Account Number:

(POL-85c must be enclosed)

a. ☐ For Base Fee.

b. ☐ For Balance of Issue Fee Due, if any.

DO NOT USE THIS SPACE.

AUG-18-70

MAILING INSTRUCTIONS

NOTE: All further correspondence, the patent together with the Notice of Balance of Issue Fee Due, if any, will be mailed to the addressee entered in the stub marked 4 at the lower left below, unless you direct otherwise by specifying the appropriate name and address in item 4a below right.

4a. Further correspondence is to be mailed to the following:

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VANCO

PLAINTIFF'S EXHIBIT

738

Form 120 (Rev. Oct. 1964)

In Re Patents

United States District Court
for the

S.D.N.Y.

COMMISSIONER OF PATENTS,
Washington 25, D. C. nyc

SIR:

In compliance with the Act of July 19, 1952 (66 Stat. 814; 35 USC 290), you are advised that there was filed on the 20th day of APRIL, 19 72, in this court an action, No. 72 Civ 1625, entitled:

Name PACIFIC PLANTRONICS, Plaintiff,

Address 111 [illegible] STREET, SANTA CRUZ, CALIFORNIA 95060

versus

Name ROANWELL CORPORATION, Defendant,

Address 180 VARICK STREET, N.Y.C. N.Y.

brought upon the following patents:

PATENT NO.	DATE OF PATENT	PATENTEE
1. 3,184,556	MAY 18th, 1965	PLTFF
2. DES. 218,[illegible]	JULY 28th, 1970	PLTFF.
3. 3,5[illegible]	DEC 15th, 1970	PLTFF.
4.		
5.		

In the above-entitled case, on the day of , 19 , the following patents have been included by (insert amendment, answer, cross bill, or other pleading):

PATENT NO.	DATE OF PATENT	PATENTEE
1.		
2.		
3.		
4.		
5.		

In the above-entitled case the following decision has been rendered or judgment issued:

JOHN LIVINGSTON
Clerk.

Date APRIL [illegible], 19 72 By JAMES [illegible]
Deputy Clerk.

452

Form PO-466
(REV. 6/67)

839016
SERIAL NO. (Series of 1960)

Assistant examiner

Group No.

Applicant

SEARCHED

Class	Sub	Date	Ex'r
179	176	MAY 1 1970	WC

INTERFERENCE SEARCHED

Class	Sub	Date	Ex'r
179	176	[illegible]	WC

INDEX OF CLAIMS

Final	Original	Date								Final	Original	Date								
		MAY 1	JUL 1																	
	1	✓									26									
	2	✓									27									
	3	✓									28									
	4	✓									29									
	5	✓									30									
	6	✓									31									
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SYMBOLS	STATUS
✓	Rejected
=	Allowed
– (Through numeral)	Canceled
+	Restriction requirement
N	Nonelected invention or species
I	Interference
A	Appeal

839016

7-3-69 2508-718

CONTENTS

1. Application papers 1 pt
2. Prel. Amdt A Dec 22, 1969
3. Pt to make Special Dec 22/69
4. Affidavit/Exhibit Dec 22/69
5. COMM'R'S DECISION Denied Jan. 21, 1970
6. Suppl To Pt - Feb 2/70
7. Com. Dec. Granted - April 1, 1970
8. Rejection (SSP) May 13, 1970 (3 mos) 5-11
9.
10. Notice of Suit April 20, 1972 7-14
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JUL 16 1970
PA QUALITY CONTROL

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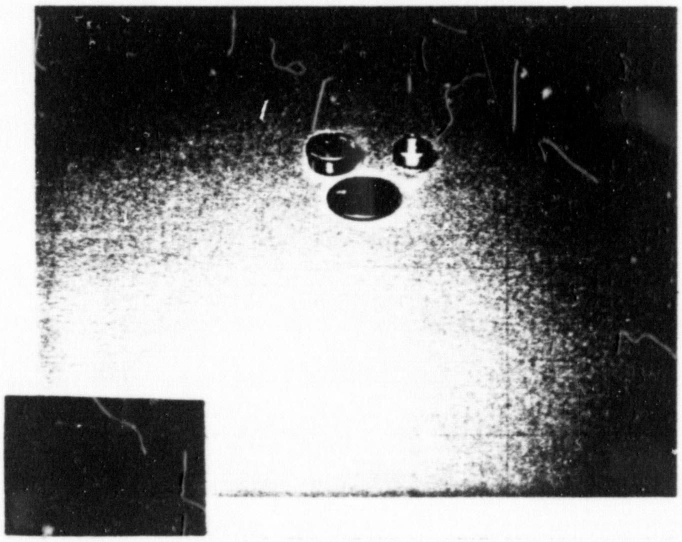
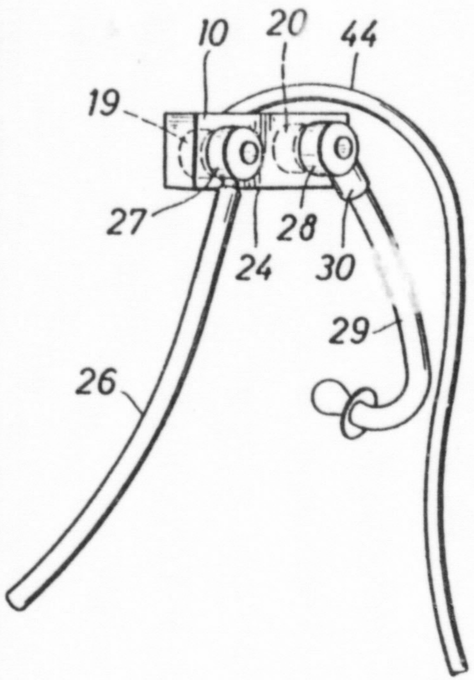
U.S. GOVERNMENT PRINTING OFFICE



Ex. 123 #55

LARKIN, FIG. 2



LARKIN, Claim 1

1. A miniaturized microphone headset employing a miniature microphone and a miniature receiver, comprising the combination of

support means for detachably supporting the miniature microphone and the miniature receiver adjacent to the wearer's ear,

a first acoustical tube, means for attaching one end of said first tube to said microphone and the other end of said first tube being adapted to be positioned adjacent to the wearer's mouth,

a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear.

Roanwell R-71

Ex. 124 [redacted]

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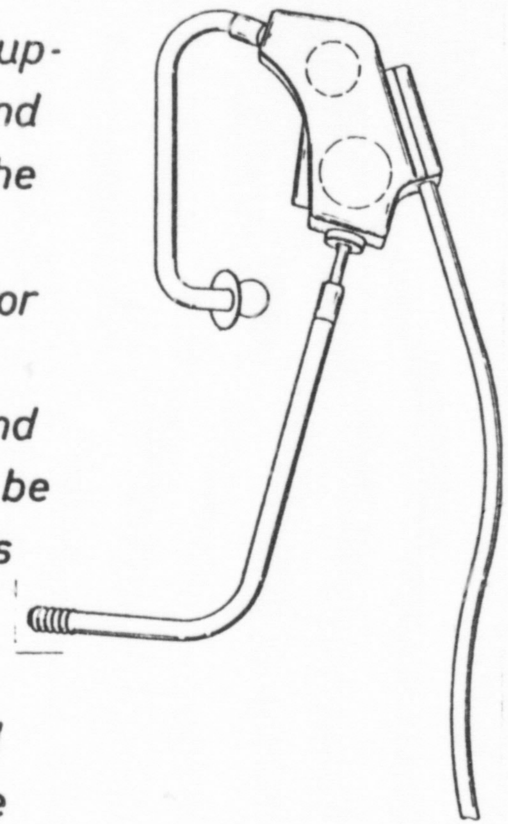

THE JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA VOLUME 16, NUMBER 3 JANUARY, 1945

The Dipole Microphone

BENJAMIN OLNEY, FRANK H. SLAYMAKER, AND WILLARD F. MEEKER
Stromberg-Carlson Company, Rochester, New York

(Received September 9, 1944)

A DIPOLE microphone is a microphone in which the response is a function of the sound pressure at two distinct points. In the particular model to be discussed in this paper, the sound pressure at each of the two selected points is transmitted through tubes to opposite sides of the microphone diaphragm. The use of tubes makes it possible to remove the microphone transducer element from a location directly in front of the talker's mouth, and yet retain the acoustical advantage of a close-talking microphone. Figure 1 shows the dipole microphone as a part of a telephone operator's set, and Fig. 2 shows an exploded view of the same set.

FIG. 1. The dipole microphone set.

The capsule containing the microphone diaphragm and the electromagnetic transducer is mounted in the same case with the telephone receiver. By careful construction it has been possible to eliminate any trouble caused by coupling between the receiver and microphone. The transparent plastic mouthpiece at the free ends of the sound conducting tubes is called the

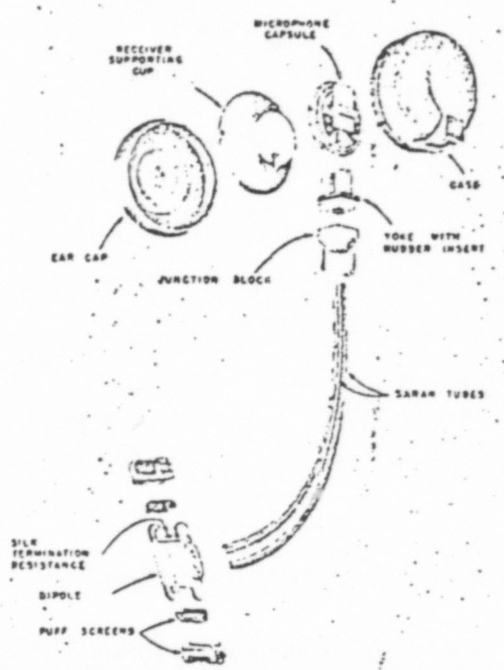

FIG. 2. Exploded view of the dipole microphone set.

dipole, although acoustically speaking, the term "dipole" should refer only to the configuration constituted by the two tube openings at the top and bottom of the plastic mouthpiece. A disk of silk cloth, which forms an acoustic resistance, covers each of the two dipole openings. The silk disks eliminate the peaks in the response curve caused by standing waves in the tubes. Two puff screens of fine mesh wire screen cover each end of the dipole. When the dipole is used very close to the mouth, these puff screens are necessary to reduce the blasting noises accompanying such explosive sounds as "p" and "t."

ANALYSIS

To analyze the performance of such a microphone, let us consider the analogous electric circuit shown in Fig. 3 where: p_1 = sound pressure at one end of the dipole, p_2 = sound pressure at the other end of the dipole, Z_{t1} = acoustic impedance terminating the first tube, including the radiation impedance, Z_{t2} = acoustic impedance terminating the second tube, including the radiation impedance, Z_{01} = characteristic acoustic impedance of the first tube, Z_{02} = characteristic acoustic impedance of the second tube, $\gamma_1=\alpha_1+j\beta_1$ = propagation constant of the first tube, $\gamma_2=\alpha_2+j\beta_2$ = propagation constant of the second tube, l_1 = length of the first tube, l_2 = length of the second tube, C_1 = acoustic compliance of the cavity on one side of the diaphragm, C_2 = acoustic compliance of the cavity on the other side of the diaphragm, L_d = acoustic inertance of the diaphragm, C_d = acoustic compliance of the diaphragm, v_d = volume velocity of the diaphragm. As this circuit can be treated by fairly straightforward analysis, the method will merely be sketched and the results given. If we enter the circuit at the line A–A we can, by using Thevenin's theorem, replace all of the circuit elements to the left of A–A by an equivalent generator having a certain open circuit voltage and a certain internal impedance. This internal impedance can be expressed by:

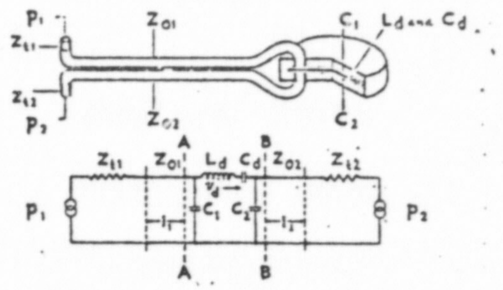

FIG. 3. Schematic diagram of the acoustical system and an analogous electrical circuit.

$$Z_{AA}=Z_{01}\tanh(\gamma_1 l_1+\gamma_{t1}), \tag{1}$$

where

$$\gamma_{t1}=\tanh^{-1}\frac{Z_{t1}}{Z_{01}}.$$

If $Z_{t1}=Z_{01}$, $\gamma_{t1}=\infty$, and Eq. (1) reduces to

$$Z_{AA}=Z_{01}. \tag{2}$$

In other words, the internal impedance of the equivalent generator is that of a transmission line terminated in its own characteristic impedance, and is, of course, substantially resistive and independent of frequency. The open circuit voltage at A–A, or, if we refer to the acoustical diagram, the blocked tube pressure at the cavity end of the top tube, is expressed by

$$p_{AA}=p_1\frac{\cosh\gamma_{t1}}{\cosh(\gamma_{t1}+\gamma_1 l_1)}. \tag{3}$$

Now, if we still assume that $Z_{t1}=Z_{01}$ we can rewrite Eq. (3) in the exponential form,

$$p_{AA}=p_1\exp(-\gamma_1 l_1)$$
$$=p_1\exp(-\alpha_1 l_1)\exp(-j\beta_1 l_1). \tag{4}$$

From Eq. (4) it is evident that, if the attenuation in the tube is small, as it is in the practical microphone, the major effect of the tube is the introduction of a phase shift and not a change in amplitude. Since the equivalent generator has a resistive internal impedance and an open circuit voltage which are both substantially independent of frequency, there are no resonance peaks introduced by the tube.

The right side of the microphone may be treated similarly, and another equivalent generator substituted for all of the circuit elements to the right of the line B–B. If the microphone be assumed perfectly symmetrical, if attenuation be neglected, and if the termination impedances match the characteristic impedances of the tubes, a much simpler circuit can be drawn as shown in Fig. 4, where $\Delta p'=(p_1-p_2)\epsilon^{-j\beta l}$. That is, as far

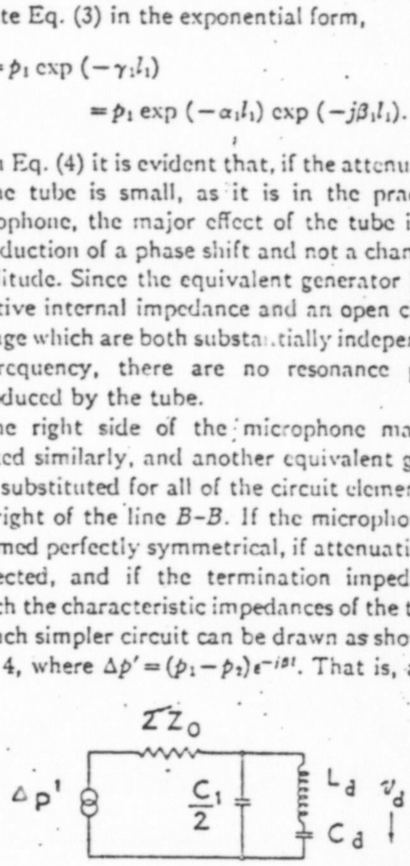

FIG. 4. Simplified equivalent circuit.

as amplitude is concerned, $\Delta p'$ is equal to the

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complex difference in pressure between the two ends of the dipole.

Since not all of the assumptions made in the simplified circuit are true for the practical microphone, the simplified circuit cannot be used for rigorous analysis. It can be used, however, to show the effect of the tubes on the sensitivity of the microphone. Since the tubes are fairly small, a little over $\frac{1}{8}$" I.D., one might suppose the use of larger tubes would increase the sensitivity. If $2Z_0$ is small compared to the parallel impedance of $C_1/2$, L_d and C_d, the velocity through L_d and C_d becomes substantially independent of both Z_0 and C_1. In the practical microphone $2Z_0$ is small compared to the parallel circuit impedance over most of the voice frequency range. Hence, there would be no particular gain in sensitivity if the tubes were larger. At diaphragm resonance, however, the impedance in the L_d, C_d branch is very low and the diaphragm velocity is controlled by the value of Z_0. Thus by the proper choice of circuit constants it is possible to control the relative height of the diaphragm resonance peak.

FREQUENCY RESPONSE

To calculate the frequency response of the microphone, it was necessary to use the first analogous circuit (Fig. 3) since in the model considered, the cavities on either side of the diaphragm did not have the same volume. The calculations for the dashed curve in Fig. 5 were

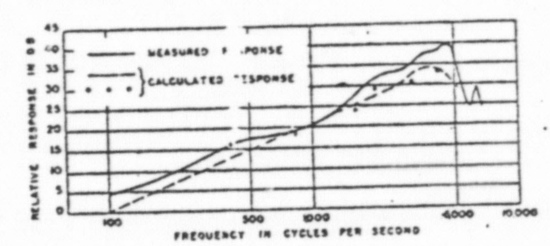

FIG. 5. Comparison of measured and calculated response of the dipole microphone.

based on the assumptions that attenuation could be neglected, that the dipole impedance matched the tube impedance, that p_2 was equal to zero, and that p_1 was constant and independent of frequency. Later in this paper, we shall investigate the pressure at the ends of the dipole more thoroughly. Since the microphone transducer was a magnetic diaphragm type unit, its open-circuit voltage was assumed to be proportional to the diaphragm velocity. The individual points were calculated after taking into account the effect of attenuation[1] on the characteristic impedance of the tube and on the propagation constant. We also used the measured value of the dipole impedance instead of assuming that it matched the tube impedance exactly. The solid curve repre-

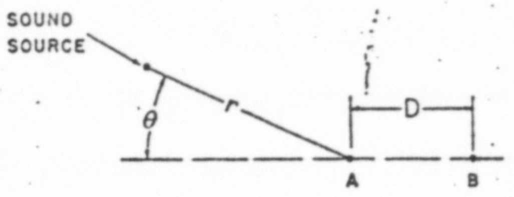

FIG. 6. Schematic representation of a sound source and a dipole microphone.

sents the measured frequency response. The measured curve shows greater high frequency response than the calculations predicted. Unfortunately, there has been no opportunity to investigate the reasons for this discrepancy. Notice, however, that a curve following the calculated points departs from a straight line at about the same frequencies as the measured curve, and the variations are of the same order of magnitude.

NOISE REDUCTION

Now let us examine the pressure at each end of the dipole a little more closely. Figure 6 shows a source of sound which for simplicity we can assume to be a point source. Of course, such an assumption means we are neglecting diffraction about the wearer's head, but it will serve as a start. At a distance r from the source is located one end of the dipole A. The other end of the dipole is located at B. Since the symmetrical microphone responds to the difference in pressure between the two ends of the dipole, let us work out an expression for the difference in pressure between A and B.

---

[1] W. P. Mason, *Electromechanical Transducers and Wave Filters* (D. Van Nostrand Company, Inc., New York, 1942), p. 118.

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We can express the pressure at A by

$$p_A = \frac{p}{r}\sin k(ct-r), \qquad (5)$$

where p = sound pressure produced by the source at a unit distance, $k=\omega/c$, $\omega=2\pi f$, c = velocity of sound. If θ is small or r is large compared to D, the pressure at B can be expressed by

$$p_B = \frac{p}{r+D\cos\theta}\sin k(ct-r-D\cos\theta). \qquad (6)$$

To obtain the difference in pressure, it is necessary merely to subtract Eq. (6) from Eq. (5). Then

$$\Delta p = \frac{p}{r}\sin k(ct-r) - \frac{p}{r+D\cos\theta} \times \sin k(ct-r-D\cos\theta). \qquad (7)$$

Two extreme conditions are of interest in practice. One applies when the sound source is very close to one end of the dipole and the other, when the source is a long distance away. For close-up use, r is small compared to D and Eq. (7) becomes

$$\Delta p \cong p/r \sin k(ct-r). \qquad (8)$$

That is, the pressure difference between the ends of the dipole is substantially equal to the pressure at A, and the pressure at B can be neglected. The measured frequency response shown in Fig. 5 was obtained by placing one end of the dipole so close to the sound source that Eq. (8) was applicable. For distant sounds, r is large compared to D and Eq. (7) becomes

$$\Delta p \cong 2\sin\frac{kD\cos\theta}{2}\,\frac{p}{r}\cos k\left(ct-r-\frac{D}{2}\cos\theta\right). \qquad (9)$$

If we compare Eqs. (6) and (9) we can see that, as far as amplitude is concerned, the difference in pressure for distant sounds is equal to the pressure at one end of the dipole multiplied by the term $2\sin[(kD\cos\theta)/2]$. Since this term becomes progressively smaller for low frequencies, it is apparent that the dipole microphone discriminates against low frequency sounds arriving from a distance. Also, since if $\theta=\pi/2$, $\cos\theta=0$, the microphone does not respond to sounds arriving from a direction perpendicular to the line connecting the two ends of the dipole. In the operator's set, the dipole is so oriented that the voices of the adjacent operators, and also the sound of the clattering plugs, arrive approximately from the direction of minimum response. For frequencies low enough that $\sin kD \cong kD$, the dipole microphone shows the familiar cosine directional characteristics which are inherent in any pressure gradient microphone. The measured directional characteristics of an early experimental dipole microphone are shown in Fig. 7.

Two effects, then, the directional characteristics and the loss of low frequency sensitivity with distance, tend to discriminate against sounds which do not originate close to one end of the dipole. In order to obtain some figure which represents the total discrimination of the microphone against all distant sounds, we can integrate the energy which the dipole microphone would receive from all directions; do the same thing for a non-directional pressure microphone; then compare the results. To make this comparison, it must be assumed, of course, that the two types of microphones have the same close-up sensitivity. An expression analogous to this comparison has been worked out for radio broadcast type microphones several times before,[2] and has been called the random energy efficiency. The random energy efficiency is given by the expression:

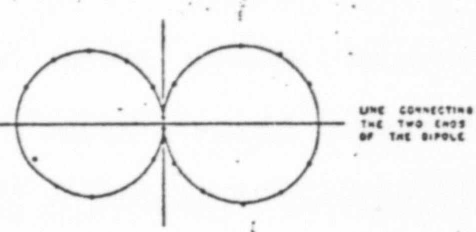

FIG. 7. Directional characteristics of an experimental dipole microphone measured at 1000 c.p.s.

$$\text{R.E.} = \tfrac{1}{2}\int_0^{\pi} f^2(\theta)\sin\theta\,d\theta, \qquad (10)$$

[2] W. P. Mason and R. N. Marshall, J. Acous. Soc. Am. 10, 214–215 (1938), Appendix A. Benjamin Baumzweiger, J. Acous. Soc. Am. 11, 477–479 (1940).

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where $f(\theta)$ is the directivity of the microphone expr- -d as a function of a plane angle θ. For conventional microphones, $f(\theta)$ is defined in terms of the maximum response of the microphone to plane waves; but since the dipole microphone is intended to discriminate against plane waves, we must redefine $f(\theta)$ in terms of

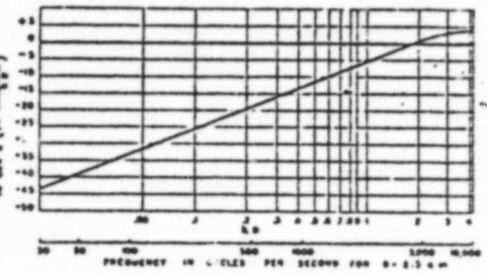

FIG. 8. Random energy efficiency of a close talking dipole microphone.

the close-up response of the dipole microphone. For the dipole microphone

$$f(\theta)=2\sin\frac{kD\cos\theta}{2}, \tag{11}$$

and

$$\text{R.E.}=2\left(1-\frac{\sin kD}{kD}\right). \tag{12}$$

For small values of kD, Eq. (12) reduces to

$$\text{R.E.}=\frac{(kD)^2}{3}. \tag{13}$$

Equations (12) and (13), then, represent the ratio of the random energy picked up by an ideal dipole microph- ne in a free field to the energy picked up by . non-directional pressure microphone, provided the two microphones have the same close-up sensitivity. Equation (12) is plotted in terms of kD in Fig. 8. For $kD\cong 1.9$, there is no discrimination against distant sounds. If the dipole spacing is 2.3 cm, the corresponding frequency would be 4.00 c.p.s.

Since a completely analytical approach to a problem is likely to in volve some rather dubious assumptions, an exper mental check of the noise discriminating proper ies of the dipole microphone seemed desirable. There was some conflicting philosophy as to just what our experiments were intended to measure. That is, were we trying to compare the performance of microphones which might have widely differing frequency characteristics, and which were intended to be used at a variety of distances from the mouth? Or, were we to isolate the effect of using a dipole pick-up device? Both the construction of the dipole microphone and the form the analysis had -en led us to adopt the second point of view. To convert the dipole microphone into a non-directional pressure microphone, it was necessary merely to substitute for one of the original tubes another tube of the same diameter which was long enough to be acoustically "infinite." Such a change would affect neither the close-up sensitivity nor the frequency response, so we decided to measure the response of both the normal and converted microphones in a random noise field.

The microphone to be tested was set up in a large irregular concrete room which had a reverberation time of about 13 seconds. Amplified thermal noise reproduced by a loudspeaker was used to supply the random noise, and the output of the microphone was measured over a series of octave bands. The loudspeaker and microphone were oriented so that, as far as the horiontal plane was concerned, there were no detectable directional effects at the microphone position. To check the possibility of noise entering the microphone through the walls of the infinite tube, two infinite tubes were substituted for the dipole. The output of the microphone with the two infinite tubes was recorded as "leakage."

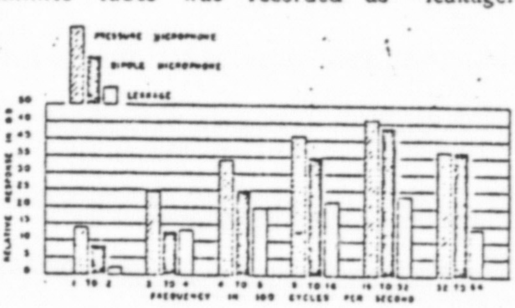

FIG. 9. Ambient noise response for dipole and pressure microphones.

Further checks seemed to indicate that most of the "leakage" noise was reaching the microphone diaphragm through the case walls rather than through the tube walls. Figure 9 shows the

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results of the noise discrimination measurements. There is, in general, a trend tow[illegible] a greater degree of discrimination for low frequencies, though the discrimination is not so great as that predicted analytically. The 3200–6400 c.p.s. band shows no discrimination at all, which agrees pretty well with the zero discrimination frequency of 4500 c.p.s. calculated for this same model.

Since the noise discrimination measurement was carried out under free field conditions, there is a legitimate objection that the test conditions were not representative of the conditions existing in actual use. Diffraction around the wearer's head had been ignored in the analysis; so as to evaluate tentatively the effects of diffraction, the experiment described above was repeated with a person wearing the microphone in the manner shown in Fig. 1. Although diffraction effects were noticeable, they were never more than one or two db.

In the foregoing analysis, we have assumed that the dipole was located very close to the source of the desired sound. It is a matter of practical interest, however, to deter[illegible] loss in effective sensitivity when the dip[illegible] far from the source that we can no longer neglect the pressur[illegible]e of its ends. If r is on the same order of m[illegible]de as D, neither Eq. (8) nor Eq. (9) is [illegible]cable. Let us look once more at Fig. 6. If $\theta=0$ we c[illegible] divide the absolute value of Δp from Eq. (7) by the absolute value of p_A from Eq. (5) and obtain, eventually, an expression which represents an effective loss in sensitivity.

From (5) and (7) if $\theta=0$,

$$\frac{|\Delta p|}{|p|}=\left[1-\frac{2r/D}{r/D+1}\cos kD+\left(\frac{r/D}{r/D+1}\right)^2\right]^{\frac{1}{2}}. \quad (14)$$

Figure 10 shows Eq. (14) plotted in terms of db for several values of kD and for r/D as the independent variable. If, for example, the dipole should be so far from the source that $r/D=0.5$, the effective loss in sensitivity would be about 3.5 db for most of the voice frequen[illegible]ange. Of course, the loss is greater for low fre[illegible]cies than for high.

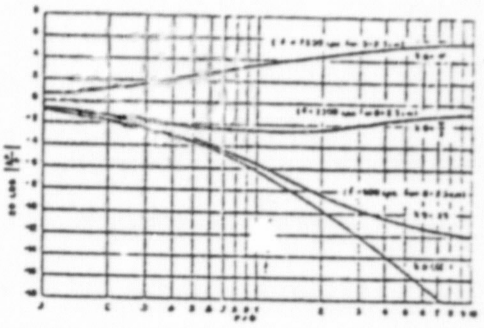

Fig. 10. Relative sensitivity as a function of the distance from the source and of the dipole spacing.

OTHER APPLICATIONS

So far we have mentioned only one application of the dipole microphone employing sound transmission tubes. If it should be desirable, for example in a distant talking microphone, the directional characteristics could be changed from the cosine type to cardioid by changing the length of one tube by an amount equal to the dipole spacing.[3] It might even be possible to construct a microphone in which one tube had an adjustable crook, like a trumpet tuning slide, and thus obtain a variety of directional patterns.

The small size of the tubes which can be used suggests the additional possibility of applying some form of tube microphone to an acoustic wattmeter, or an impedance measuring device, where it is desirable to make measurements without disturbing the sound field. The velocity component could be measured with some form of the dipole microphone, while the pressure measuring element could be a single-tube microphone with the open end of the tube terminated in the appropriate resistance.

[3] H. F. Olson, *Elements of Acoustical Engineering* (D. Van Nostrand Company, Inc., New York, 1940), p. 210.

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PLAINTIFF'S EXHIBIT 126

HUTCHINGS, Claim 1

Roanwell R-70

1. A headset comprising

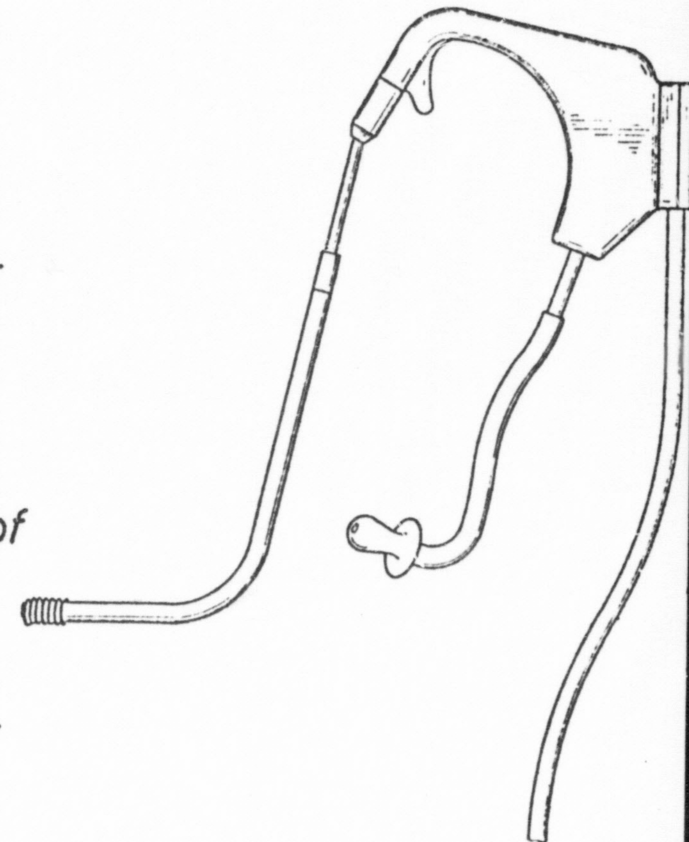
a housing adapted to be placed behind the ear of a user, said housing including an integral upper curved extension adapted to extend over and engage the top of the ear,

a microphone disposed in and near the top of said housing,

a forwardly extending voice tube communicating with said microphone and positionably secured to the upper extension of said housing, said voice tube being adapted to have its distal end positioned adjacent the user's mouth,

a receiver disposed in and near the bottom of said housing,

and a flexible tube secured to the bottom of the housing and adapted to provide communication to the auditory canal of the user's ear.



Ex. 126 463

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PLAINTIFF'S
EXHIBIT
127

Ex. 127 464

Serial No. (Series of 1966) | 15 Years | NUMBER

(451)

VANCO

PLAINTIFF'S EXHIBIT 128

o hearing aids, inc. / p. o. box 1289 / telephone 446-7795 / clearwater, flo

Dear Hearing Aid Distributor:

20 million people in the United States have deficient hearing. Half of these or 10 million, have losses which warrant the use of a hearing aid. In spite of this fantastic market, the industry sold a mere 344,000 new units in 1962. This is a loss of over 2,000 aids per month compared to 1961 and a loss of over 4,000 aids per month compared to 1960. Great technical advances have been made. Much has been done to popularize hearing aids. Medical science has lengthened our life span and the future will see a greatly expanded potential market. Everything points to the industry selling many more units, but the sales decline... The road-block is "price".

More people refuse to buy because of price than for all other reasons combined. The simple truth is our industry has worked from the beginning to justify high price. Continuing to talk about the high cost of tooling, engineering, research, selling, advertising and servicing will not make the public believe it. We will not reverse the present sales trend and make a significant break-through saleswise until we can start selling people hearing aids at prices they are willing to pay.

Our industry had its greatest hour when the average retail price was about $200.00. We have gone too far with price. We face a dim future unless we return to a price level acceptable to the public. Everyone agrees you must operate with a high profit margin and that you could not afford to reduce prices by shortening your profit ratio. However, if you could expose yourself to the vast market presently opposed to high prices, and do this with an improved profit ratio, your profits would increase and the unit sales would quickly reverse the present sales trend. You can do this with VANCO...

Whenever the word "price" is mentioned, the word "quality" is not far behind. Quality is the most overworked sales word in the industry and it has become a state of mind rather than an indication of value. May I suggest a thought for your serious consideration? Now, in the silicon transistor era, a particular group of components is required to make a good hearing aid. Every company making a good aid buys the same group of parts and buys them from the same suppliers. When two aids are compared, both containing the same components, how can one be a quality aid and the other not? We buy nothing but the best grade of components and you can be sure those parts do not work one bit better when used in brand "X", "Y" or "Z".

This is the time to take quality for granted because all good companies use quality materials and start selling the public something they will buy -- "value".

Sincerely,

VANCO Hearing Aids, Inc.

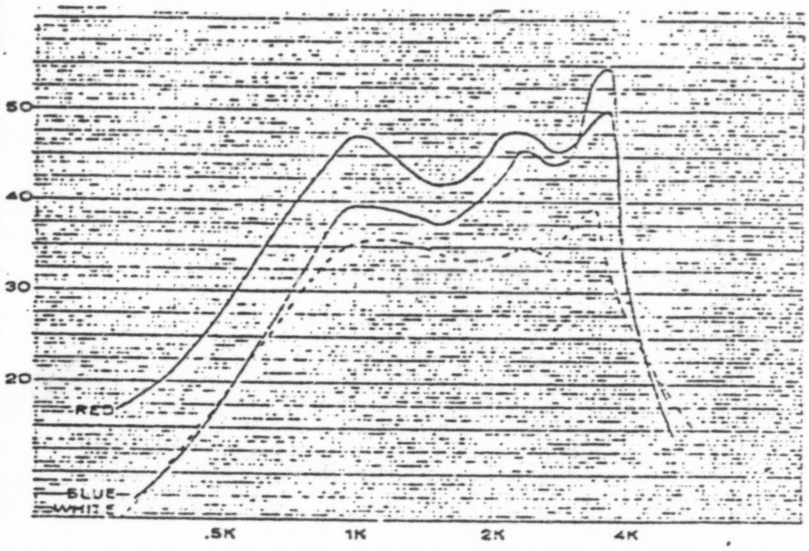
G. A. Van Schenck, Jr.
President

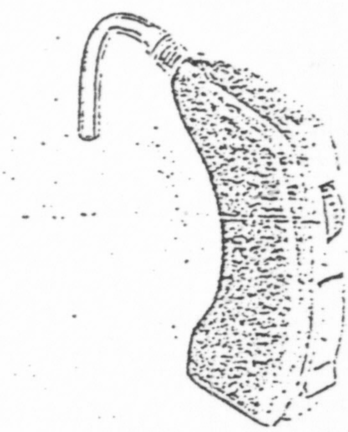
EX. 128 (465)

17718 | TERM OF PATENT 14 Years | DESIGN PATENT NUMBER

Serial No. (Series of 1966)

VANCO Proudly Announces The New MINI-EAR®





Using the New *NPN SILICON PLANAR* Transistors for More Power – More Clarity – Better Temperature Control.

And the New *SILVER OXIDE* Battery with Greater Power (a Full 1.5 volts) for Better Hearing.

NO BATTERY NOISE — TROUBLE FREE SERVICE — ALL WEATHER USE — LONG SERVICE AND SHELF LIFE.

TRANSISTORS: 3 NPN SILICON PLANAR (High Beta)

BATTERY: S-76E (Silver Oxide)

BATTERY LIFE: 85-90 HOURS

COLOR: BEIGE

WITH A CHOICE OF THREE DIFFERENT CIRCUITS
RED DOT: STANDARD; BLUE DOT: NERVE; WHITE DOT: MILD

PEAK GAIN: 54 DB

AVERAGE GAIN: 42 DB (400 - 4,000 CPS)

SIMPLIFIED CHASSIS --
No "Gadgets" to cause trouble.

ONE YEAR GUARANTEE WITH 6 MONTHS NEW INSTRUMENT REPLACEMENT

166

QUALITY — VALUE — VANCO

+ .... Restriction requirement
N .... Nonelected invention or species
I .... Interference
A .... Appeal

SINGLE - UNIT	THREE UNITS	FIVE UNITS
$51.00	$48.50 ea.	$46.00 ea.

SUGGESTED LIST PRICE: $200.00
TERMS: Net Cash with order
Shipping charges prepaid.

During the first half of 1963 industry sales were less than 3 units per person per month.

Hundreds of dealers have told us they could sell more aids at lower prices, but refuse to do so because they do not make enough money.

This is why we are introducing the "MINI-EAR". The lower wholesale price permits you to increase your sales, retaining the adequate mark-up you need for a profitable operation.

Remember, the "MINI-EAR" is not made as a "price" instrument. It incorporates the latest electronic achievements made possible by the silicon transistor and the silver oxide battery. It is a product second to none and offers more "VALUE" to you and your customer than ever before.

IT WON'T COST YOU A CENT TO TRY THE "MINI-EAR". YOU'LL BE MIGHTY GLAD YOU DID . . .

All replies confidential

PROTECTED TERRITORIES
AVAILABLE TO
QUALIFIED DISTRIBUTORS

VANCO HEARING AIDS, INC.
P. O. Box 1239
Clearwater, Florida

Yes, I'd like to try the new VANCO "MINI-EAR".

I understand I may return this initial order for refund within 15 days if I am not completely satisfied.

NAME ____________________

STREET ADDRESS ____________________

CITY ____________________ STATE ________

Ship me ________ "MINI-EAR"   Check enclosed ________

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36.

(454)

IMPORTANT HEARING AID NEWS!

A New Era In Hearing Aids...

Dr. Kenneth W. Berger
Speech & Hearing Clinic
Kent State Univ.
Kent, Ohio sch

(468)

JUN 16 1969

VANCO

VANCO INDUSTRIES, INC.
Hearing Aid Division

OCT 1974
K. LEBACK

October 14, 1974

Ms. Karen Leback
Cooper, Dunham, Clark, Griffin & Moran
30 Rockefeller Plaza
New York, New York 10020

Dear Ms. Leback:

The model you have in your possession , serial number 18225 is Vanco's MINI-EAR.

This model was released in September of 1963 and the serial number series used starts at 10,000.

Should you require additional information please let me hear from you.

Sincerely yours,

VANCO INDUSTRIES, INC.

Stefan D. Van Schenck
Vice President

SDVS:mm

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1955 Sherwood St. • P.O. Box Q • Cleanwater, Florida 33518 • Phone (813) 446-8392

IN THE UNITED STATES PATENT OFFICE

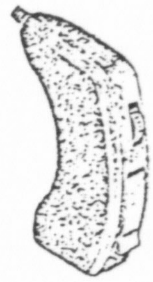
section 1001 of ... the validity of

VANCO

MINI-EAR

FEATURES

LOWEST PRICE
STURDY CASE DESIGN
ECONOMICAL OPERATION
MODERATE GAIN



The MINI-EAR is VANCO's lowest priced hearing aid designed for those who cannot afford a smaller and more elaborate instrument. The MINI-EAR has moderate gain and very sturdy design.

SPECIFICATIONS

Gain ....38 db
Output ....112 db
Frequency Range .... 400 to 3800 Hz
Battery & Life .... 675 - 150 hours
Circuit .... 3 Silicon Transistor
Response ....Standard Harvard Curve

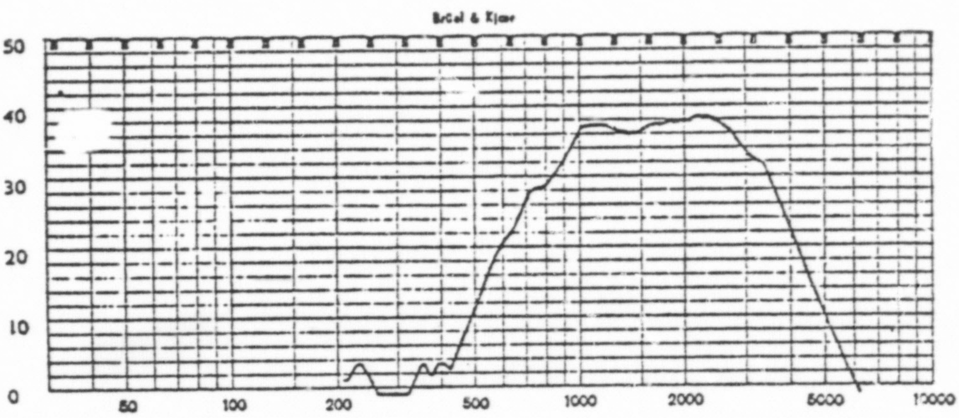
(Response on Back)

470

VANCO INDUSTRIES, INC.
1955 SHERWOOD STREET
PHONE (613) 446-6392
POST OFFICE BOX O
CLEARWATER, FLORIDA 33518

section 1001 of Title 18 of the United States Code and that
... the validity of

Frequency Response Curve of MINI-EAR



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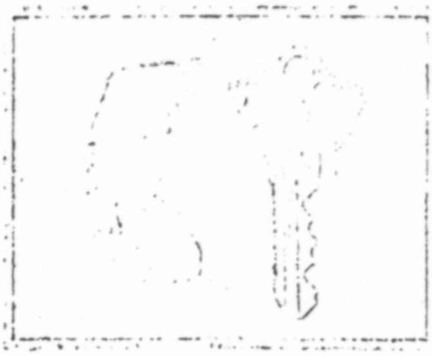

Smaller and lighter than ever before!

QUALITONE'S SENSATIONALLY SMALLER, AND LIGHTER-THAN-EVER EAR-LEVEL INSTRUMENT . . .

- Cuts inventory costs in half because it fits either ear!
- Can be used for mild or heavy losses!

COMPARE THESE [illegible] FEATURES THAT MAKE SELLING EASIER:

PLAINTIFF'S EXHIBIT 129

(Also available at no extra cost—Special White Dot circuit for difficult nerve losses.)

for full line product leadership, instruments that sell easier, better dealer profits and benefits!

This can be the most rewarding decision you've ever made!

QUALITONE

WORLD WIDE HEARING SERVICE

Qualitone Hearing Aid Co.
Linden Hills Station
Minneapolis 10, Minnesota

- ☐ Send confidential information about Qualitone.
- ☐ Send Sub-Miniature on 10-day return-privilege trial.
- ☐ Send special White Dot Sub-Miniature for nerve losses on 10-day return-privilege trial.

Name ....

Address ....

City .... State..............

Ex. 129 472

SHAA . . . . Bulletin

Y'All Come

by D. Dale Hughes

Executive Director
Society of Hearing Aid Audiologists

□ You've heard the story, you've read the news: It's time for the SHAA Annual Meeting!

By the time you receive this publication you have just the time left before the opening gavel to pack a toothbrush, snag a plane, and get to Chicago. But do it! You'll never regret it. If you miss the first day — don't miss the second. Just be there!

Look at that list of seminar subjects! Bet you wish you could attend all of them. Pick the four most important to you. Cover them.

Look at the list of speakers. The entertainment. The gathering of the hearing aid clan.

It's the event of the year.

Come one, come all — you sure don't have to be a member of the Society of Hearing Aid Audiologists to attend. You're welcome.

The SHAA wants *you* there. The SHAA sincerely wants to be instrumental in helping every hearing aid dealer to know more about his or her job. The SHAA honestly believes that the better informed a dealer is, the more ethical will be his or her performance — the more sincere his or her service to America's hard of hearing. That's why it welcomes member and non-member alike. That's why you can come to this meeting no matter how long you have been in the business — or how deeply you are involved. It's for *you!*

Why does the Society want you to be informed so that you can be even more ethical? Simply because we are all in this business together. Any act, by member or non-member, if it is unethical reflects on the entire industry — not just on those who are not yet certified by the SHAA. That's why the Basic Home Study Course in Hearing Aid Audiology is available to everyone— applicants for certification and non-applicants alike.

So, here it is—the annual moment of truth for hearing aid dealers. Will you advance yourself in your chosen field? Will you help to prepare yourself for the next step in your chosen career? Will you attend this prime educational event so that your entire industry might advance.

We hope you will. We hope we see you in Chicago, at the Sherman House, on November 8 thru 10. You'll be glad you came.

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Expansion Program

R. K. Clark

[illegible] K. Clark, president of [illegible] Electronics, Inc., Minneapolis, [illegible] of [illegible] Hearing Aids, announces the [illegible] of his [illegible] and expansion program. [illegible]

The latest [illegible] have been added to the laboratory, making [illegible] the high standards [illegible] Clark stated that "The year marks [illegible] 25th year as a continuous manufacturer [illegible] additional models to the [illegible] will be announced within the next 30 days."

Two New Aids From Maico

"Selectronic III"

Maico Electronics, Minneapolis, recently announced the addition of two new hearing aids to the Maico line.

The "Selectronic III" (Model BK) is a high gain, high power behind-the-ear hearing aid. Its six-transistor, two diode circuit has a push-pull output stage to give high power, operating economy and low distortion. Operating stability over a wide range of temperature variation is attained by the use of thermistor circuitry. The hearing aid is powered by a single mercury or silver oxide cell. A built in telephone pickup is provided to assist the user in telephone conversations. Designed for the person who wants the convenience of a hearing aid worn at the ear, but requires power and gain, the "Selectronic III" features over 50 decibels peak amplification and [illegible] decibels peak power.

The Maico "Claridge" (Model BN) is a high gain, medium power pocket wearing aid. Because of its small size and light weight, it can be worn on a bar with the clip or on the body as desired. The "Claridge" uses a six transistor circuit terminating in a push pull output stage. Two thermistors are used to attain operating stability over a wide range of temperature variation. A single Mallory [illegible] is used to supply power to the instrument. An internal [illegible] is used to provide two low tone adjustments. [illegible] conduction receivers, two ComfortEar inserts and one bone conduction vibrator are available for fitting flexibility. The "Claridge" features 70 db amplification and 130-plus db power, in a new "sculptured" case finish that has less contact surface and reduces the possibility of rub noise.

"Claridge"

Widex Goes To Cartoon-Type Mats

New theme for Widex Hearing Aid Company's cooperative advertising program is "Everything Sounds Better When Heard Clearly Through A Widex Hearing Aid". A cartoon-type ad format has been used for the ad mats eliminating the standard phrases including "deaf" and "hard of hearing". Related local promotions have also been made available.

[illegible] Introduces The Hidden Ear II

Hidden Ear II

Richard I. Burger, president of Qualitone announces the introduction of the Hidden Ear II series, an all new hearing aid available in four circuits. Featuring Qualitone's behind-the-ear contour design, the Hidden Ear II is exceptionally small to effect inconspicuous wear.

The Hidden Ear II Super is engineered to meet the needs of a conductive, mixed or nerve loss, with a high frequency drop after 2000 cps. It has an acoustic gain of 41 db and a maximum output of [illegible] db. The Deluxe series is designed for a similar type of loss as the Super, but for a need where less gain and output are required. It has an acoustic gain of 32 db and a maximum output of 113 db.

The White Dot is designed to fit a nerve loss in which the drop starts at 1000 cps. It has a maximum gain of 31 db and output of 116 db. All four circuits feature an extremely low distortion rate of 1%.

Win Pederson, sales manager, stated that, "Because of excellent dealer reception we have very high expectations for Hidden Ear II. Its brilliance of reception and wide-range circuits give it a flexibility that enables the dealer to make accurate fittings more easily."

Zenith Aids Hit Chicago Financial Pages

Two articles in a series by Ronald Kotulak of the Chicago Tribune devoted to electronics dealt with Zenith hearing aid circuitry. Articles were full length discussions of hearing aids and traced the history of instrumentation to the present electronic stage.

Wendell Youngest Member of NSSTE

Herbert Wendell, training director, Maico Electronics, has been accepted as a member of the National Society of Sales Training Executives. Wendell is the youngest member of the Society which is limited to 125 active members whose responsibilities include the selection of salesmen and product training.

A New Program for High Reliability Power Sources in Medical Electronics

A new illustrated booklet, "One Hundred Million [illegible] Heartbeats", has just been issued by the Mallory Battery Company. The booklet describes the use of high reliability power sources for application in medical electronics. Special applications cited as being under extensive study are: cardiac stimulators involving the Stokes-Adams syndrome, electrical stimulation of the carotid-sinus region, for control of hypertension, the electrical control of the bladder and urinary tract, the stimulation of the eighth nerve in certain hearing defects, stimulation of the phrenic nerve to promote breathing in paralytic patients, and others.

Printed in full color and illustrated with charts and graphs showing test results, the booklet explains in detail the [illegible] Cell Program instituted by Mallory. This program [illegible] to provide to manufacturers of implantable electronic equipment, the highest possible uniformity and reliability in primary power sources.

Available free to physicians, medical students, and electronic design engineers, a copy of the booklet may be obtained from the Mallory Battery Company, South Broadway, Tarrytown, New York 10591.

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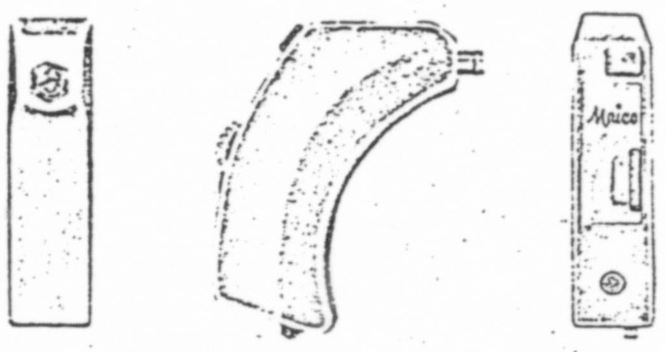
Maico

Selectronic I

PRECISION TUNED HEARING AID

MODEL BI

PLAINTIFF'S EXHIBIT 130



MAICO SELECTRONIC I Behind-the-Ear Hearing Aid

FEATURES

MEDIUM GAIN AND LOW POWER OUTPUT
TELEPHONE PICKUP (OPTIONAL)
SEPARATE VOLUME CONTROL AND ON-OFF SWITCH
TEMPERATURE STABILIZED CIRCUITRY
FOUR LO-CUT TONE SELECTORS
THREE COMFORTEAR SOUND GOVERNORS

CONTOURED TO FIT SECURELY BEHIND THE EAR

DESIGNED FOR MONAURAL OR BINAURAL USAGE

PREFORMED TUBING CONNECTOR

PERSPIRATION RESISTANT CONSTRUCTION

VERY LOW OPERATING COST

SPECIFICATIONS

	S41E	RM41GH
ACOUSTIC GAIN (Maximum):	53 db	48 db
ACOUSTIC GAIN (1000 cps):	44 db	39 db
ACOUSTIC GAIN (HAIC) (Maximum):	43 db	38 db
POWER OUTPUT (Maximum):	117 db	115 db
POWER OUTPUT (HAIC):	115 db	113 db
FREQUENCY RANGE (HAIC):	340 – 4500 cps	
BATTERY LIFE	420 hrs.	525 hrs.

PART NO. 316 – MODEL BI

TRANSMITTER COMPLETE WITH CASE (EARMOLD NOT INCLUDED)

Ex. 130 475

MODEL BI

Selectronic I

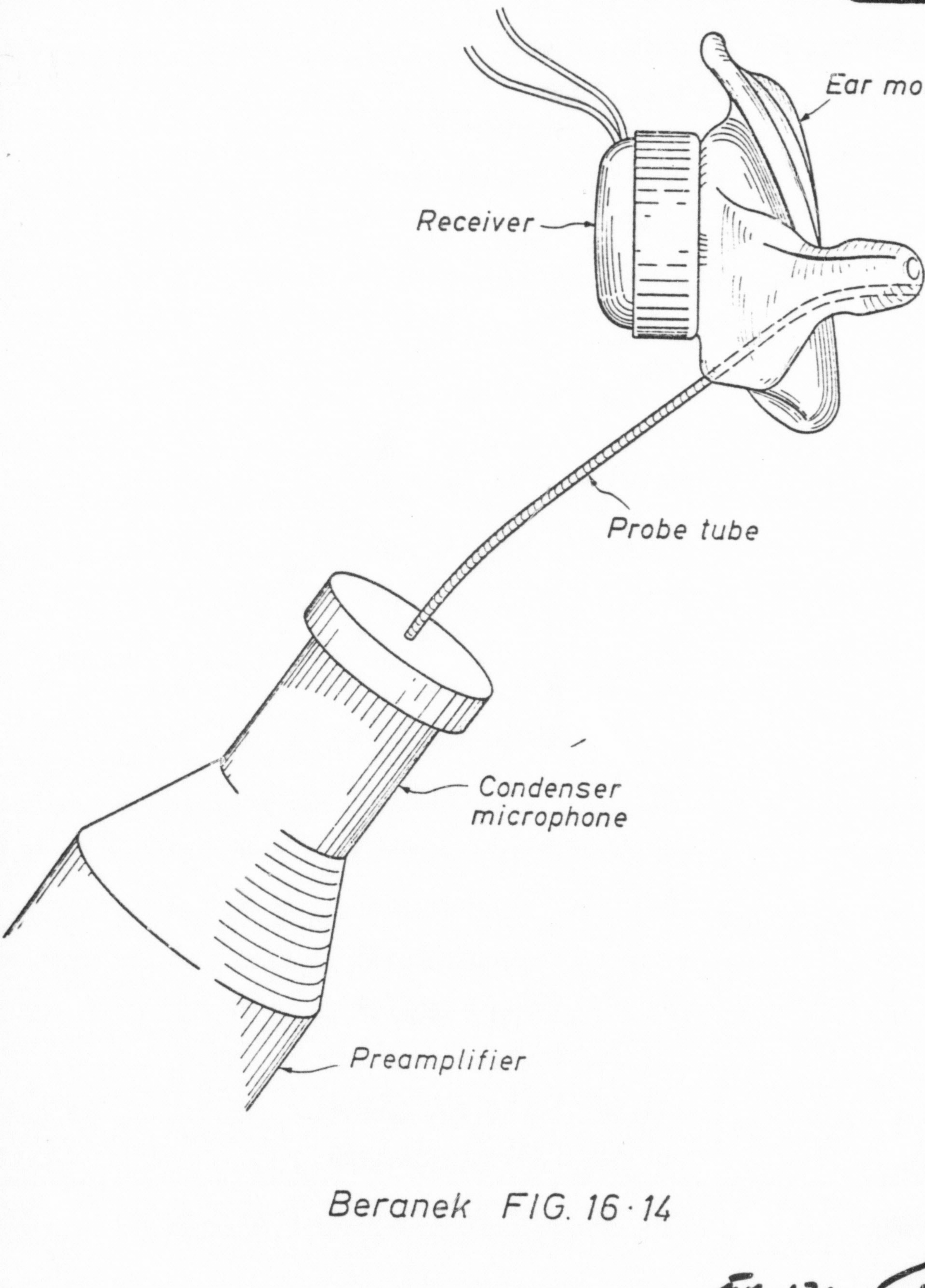
PRECISION TUNED HEARING AID

Maico

REPLACEMENT PARTS AND ACCESSORIES

PART NUMBER BROWN	FLESH	ITEM
316A	316F	SELECTRONIC I TRANSMITTER
316T-A	316T-F	SELECTRONIC I TRANSMITTER WITH TELEPHONE PICKUP
6349A	6349	TONE SELECTOR, BLUE
6351A	6351	TONE SELECTOR, YELLOW
6352A	6352	TONE SELECTOR, ORANGE
6353A	6353	TONE SELECTOR, PURPLE
6235		TUBING CONNECTOR (KIT OF 10)
4779		EAR PIECE, CLEAR
RM41GH		BATTERY, MALLORY
S41E		BATTERY, EVEREADY
6335		RETAINER RING KIT
6354		PRESENTATION CASE
6345		COMFORTEAR SOUND GOVERNOR, BROWN
6346		COMFORTEAR SOUND GOVERNOR, YELLOW
6347		COMFORTEAR SOUND GOVERNOR, RED

476



Beranek FIG. 16·14

Ex. 131 477

PLAINTIFF'S EXHIBIT 132

TERMINAL [illegible]

DATED

Filing Fee

[illegible] AND RECEIVER INSTRUMENT

W. B. Walden

APR 9 1974

Ex. 132 478

17718
Serial No. (Series of 1966)

TERM OF PATENT
14 Years

DESIGN PATENT NUMBER 218173

DATED JUL 28 1970

Assistant Examiner: BA

Class: 26

Design Group: 291

Filed Complete (Date): JUNE 16, 1969

Serial No.: 17 718

CLAIMS FOREIGN PRIORITY

Country	Date

IF NO CLAIM IS MADE, CHECK HERE ☒

APPLICATION NO.	PATENT NO.
INT. CL. D 14-01	

Class	Subclass
D 26	14

Applicant(s)

HUTCHINGS, KENNETH J. OF SOQUEL, CALIF.

Assignor to Pacific Plantronics, Inc., Santa Cruz, Calif., a corp. of California.

Title of Invention

A COMBINED MICROPHONE AND RECEIVER INSTRUMENT

☐ DIVISION OF: S.N. FILED GRANTED PAT. NO.

☐ CONTINUATION OF: S.N. FILED

☐ SUBSTITUTE FOR: S.N. FILED

☒ NONE

CONTINUATION-IN-PART OF: S.N. FILED NONE ☒

Sheets of Drw.	Filing Fee	Transaction	
1	$20	153747	DA24547

Send Correspondence to:

FLEHR, HOHBACH, TEST, ALBRITTON AND HERBERT

160 SANSOME ST.

SAN FRANCISCO, CALIF. 94104

Principal Attorney(s) FLEHR, HOHBACH, TEST, ALBRITTON AND HERBERT

Associate Attorney(s)

PARTS OF APPLICATION FILED SEPARATELY

PREPARED FOR ISSUE

(Assistant Examiner) (Docket Clerk)

EXAMINED AND PASSED FOR ISSUE

BERNARD ANSHER

(Primary Examiner Design Group)

NOTICE OF ALLOWANCE MAILED

APR 8 1970

EXTENSION FEE

Date APR 27 1970

Amount 47

MW

(THIS SPACE RESERVED FOR RETENTION LABEL)

(THIS SPACE RESERVED)

L.C.D.

173

1-8-69

RECEIVED

JUL 25 1969

IN THE UNITED STATES PATENT OFFICE

S P E C I F I C A T I O N

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN that I, KENNETH J. HUTCHINGS, a citizen of the United States of America, residing in Soquel, California, have invented a new, original and ornamental design for A COMBINED ~~a~~ MICROPHONE AND RECEIVER INSTRUMENT of which the following is a specification, reference being had to the accompanying drawing, forming a part hereof, wherein:

P. Ex. Amdt

FIGURE 1 is a perspective view of the COMBINED MICROPHONE AND RECEIVER INSTRUMENT;

P-Ex. Amdt

FIGURE 2 is a side elevational view of the COMBINED MICROPHONE AND RECEIVER INSTRUMENT;

" "

FIGURE 3 is a rear ~~back~~ elevational view of the COMBINED MICROPHONE AND RECEIVER INSTRUMENT; and

" "

FIGURE 4 is a top plan ~~elevational~~ view of the COMBINED MICROPHONE AND RECEIVER INSTRUMENT.

" "

The tubular members are fragmentarily shown for ease of illustration.

I CLAIM:

The ornamental design for A COMBINED ~~a~~ MICROPHONE AND RECEIVER INSTRUMENT, substantially as shown and described.

" "

Kenneth J. Hutchings

Kenneth J. Hutchings

479A

JUN 16 1969
U.S. PATENT OFFICE

17718

IN THE UNITED STATES PATENT OFFICE

PETITION

TO THE COMMISSIONER OF PATENTS:

Your petitioner, KENNETH J. HUTCHINGS, a citizen of the United States of America and resident of Soquel, California, whose post office address is 3736 Valerea Drive prays that Letters Patent may be granted to him ~~for the term of three and one-half years~~ (applicant reserving unto himself the right to extend the term of this patent before issuance thereof) for the new and original design for A COMBINED MICROPHONE AND RECEIVER INSTRUMENT as set forth in the following specification.

Re Ex Amdt

And I hereby appoint FLEHR, HOHBACH, TEST, ALBRITTON & HERBERT (Registration No. 15,929) of 160 Sansome Street, San Francisco, California 94104, my attorneys, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

Signed at Santa Cruz, California, this 2 day of June, 1969.

Kenneth J. Hutchings

Kenneth J. Hutchings

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IN THE UNITED STATES PATENT OFFICE

D E C L A R A T I O N

KENNETH J. HUTCHINGS, the above named petitioner, declares that he is a citizen of the United States of America, and resident of Soquel, California, that he verily believes himself to be the original, first and sole inventor of the design for a MICROPHONE AND RECEIVER INSTRUMENT described and claimed in the foregoing specification; that he does not know and does not believe that the same was ever known or used before his invention thereof, or patented or described in any printed publication in any country before his invention thereof, or more than one year prior to this application, or in public use or on sale in the United States more than one year prior to this application; that said design has not been patented in any country foreign to the United States on an application filed by me or my legal representatives or assigns more than six months prior to this application; and that no application for patent on said design has been filed by me or my legal representatives or assigns in any country foreign to the United States.

The undersigned petitioner declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under

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section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Kenneth J. Hutchings

Kenneth J. Hutchings

Date: June 2 1969.

Post Office Address: 3736 Valerea Drive
Soquel, California

WITNESSES:

482

17718

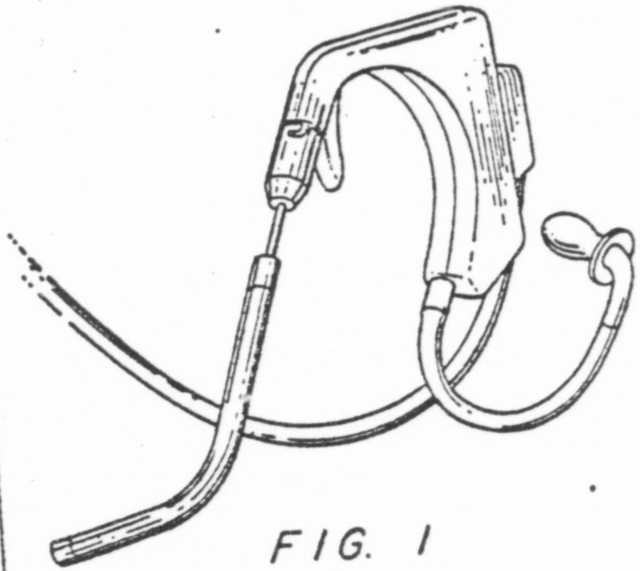

FIG. 1

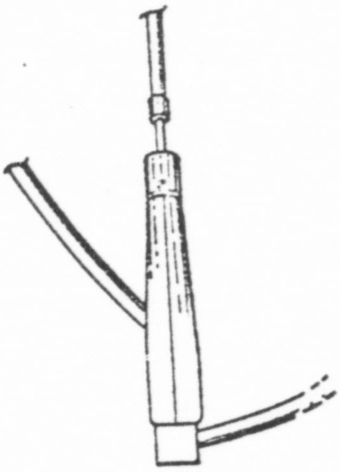

FIG. 4

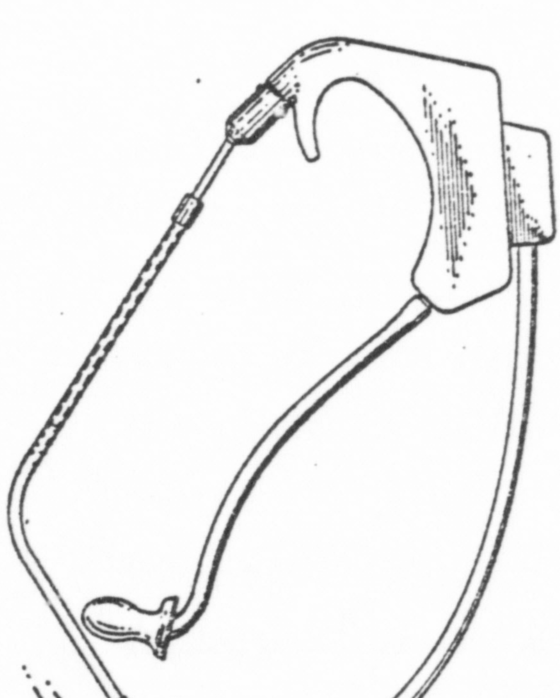

FIG. 2

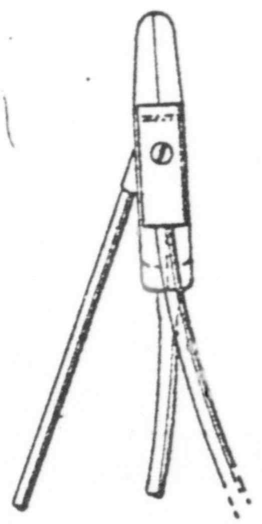

FIG. 3

INVENTOR
KENNETH J. HUTCHINGS
BY Flehr, Hohbach, Test, Albritton & Herbert
ATTORNEYS

483

U.S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON, D.C. 20231

THE COMMISSIONER OF PATENTS
WASHINGTON, D.C. 20231

Paper No. 2

In Reply Please Refer To The Following:

Mailed

EXAMINER'S NAME Bernard Ansher		
291	June 16, 1969	17 718
GR. ART UN.	FILING DATE	SERIAL NO.
Kenneth J. Hutchings		
APPLICANT	INVENTION	
MICROPHONE AND RECEIVER INSTRUMENT		

MAILED
DEC 18 1969
GROUP 250

Flehr, Hohbach, Test, Albritton &
Herbert
160 Sansome St.,
San Francisco, Calif. 94104

Below is a communication from the EXAMINER in charge of this application.

Commissioner of Patents.

☒ This application has been examined.

☐ Responsive to communication filed ____________.

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS ACTION IS SET TO EXPIRE Two MONTHS ________ ~~DAYS~~ FROM THE DATE OF THIS LETTER.

The following attachment(s) are part of this action:

a. ☒ Notice of References Cited, PO-892.
b. ☐ Notice of Informal Patent Drawing, PO-948.
c. ☐ Notice of Informal Patent Application, PO-152.
d. ☐

Summary of Action

1. ☒ Claim~~s~~ ____________ ~~are~~ is presented for examination.
2. ☐ Claims ____________ are allowed.
3. ☒ Claim~~s~~ ____________ would be allowable if amended as indicated.
4. ☐ Claims ____________ are rejected.
5. ☐ Claims ____________ are objected to.
6. ☐ Claims ____________ are subject to restriction or election requirement.
7. ☐ Claims ____________ are withdrawn from consideration.
8. ☒ Since this application appears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11, 453, OG. 213.
9. ☐ Since it appears that a discussion with applicant's representative may result in agreements whereby the application may be placed in condition for allowance, the examiner will telephone the representative within about 2 weeks from the date of this letter.
10. ☐ This action is made final.

POL-326 (10-68)

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In view of the "Revised Design Patent Practice" (O.G. Volume 860 No. 4) dated March 25, 1969 and MPEP 1503.02.

Applicant is advised to authorize the Official Draftsman to change all broken lines to full lines.

Also the fragmentary tubular ends should be finished off in all views.

BAnsher:ac
Area Code 703
557-2172

Bernard Ansher
BERNARD ANSHER
EXAMINER

485

ATTACHMENT TO PAPER NO. 2

U.S. DEPARTMENT OF COMMERCE PATENT OFFICE

NOTICE OF REFERENCES CITED

SERIAL NO. 17,718

GROUP ART UNIT 290

APPLICANT(S) HUTCHINGS

... is a supplemental citation ... additional folders

U.S. PATENTS

PATENT NO.	DATE	PATENTEE	CLASS	SUB-CLASS	FILING DATE IF APPROPRIATE
D159223	7-1950	OLSON	D-26	14 (~~14-7~~)	
2993962	7-1961	HOTHEM	179	156	
3327807	6-1967	MULLIN	181	23	

MAILED
DEC 18 1969
GROUP 290

FOREIGN REFERENCES

PATENT NO.	DATE	COUNTRY	NAME	CLASS	SUB-CLASS	PERTINENT SHTS. DWG.	PP. SPEC.

OTHER REFERENCES (Include author, title, date, pertinent pages, etc.)

...SHER

DATE 10-16-69

☐ Check here if foreign exchange

486

24547

IN THE UNITED STATES PATENT OFFICE

Received

DEC 30 1969

U. S. PATENT OFFICE

In re application of:

KENNETH J. HUTCHINGS

Serial No.: D 17,718

Filed: 16 June 1969

For: MICROPHONE & RECIEVER INSTRUMENT

San Francisco, California

December 3, 1969

PETITION FOR RETROACTIVE LICENSE

The Commissioner of Patents

Washington, D.C. 20231

Sir:

This is a petition for the grant of a retroactive license under the provisions of 35 USC 184.

The above-identified design application has been inadvertently forwarded for filing abroad without an export license under the provisions of 35 USC 184.

The above application does not disclose an invention within the scope of 35 USC 181.

Affidavits of Aldo J. Test, Esq. and Randee C. Seiger are attached explaining the circumstances which caused the failure to obtain a license prior to forwarding the design applications to Canada, France, Germany, Great Britain, Japan and Sweden for filing.

It is requested that in view of the circumstances set forth in the accompanying affidavits, that applicant be granted

APPROVED
U. S. Patent Office
JAN 2 1970
DEPUTY SECURITY OFFICER

RECOMMENDED
JAN 27 1970
Security Group
LICENSING & REVIEW

487

a license retroactive to November 18, 1969, the date of mailing of Convention applications to the firm's foreign associates for filing.

Respectively submitted,

FLEHR, HOHBACH, TEST,
ALBRITTON & HERBERT
Attorneys for Applicant

By
Aldo J. Test

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IN THE UNITED STATES PATENT OFFICE

In re application of

KENNETH J. HUTCHINGS

Serial No. D 17,718

Filed: 16 June 1969

For: MICROPHONE AND RECEIVER INSTRUMENT

A F F I D A V I T

STATE OF CALIFORNIA)
CITY &) ss
COUNTY OF SAN FRANCISCO)

I, ALDO J. TEST, being duly sworn, hereby state that:

1. I am a partner in the firm of Flehr, Hohbach, Test, Albritton, & Herbert, attorneys of record in the above-entitled application.

2. The practice of the firm has always involved a substantial amount of foreign work, including the preparation and filing of foreign patent and trademark applications, and maintenance of records with respect to foreign taxes, annuities, etc. regarding same. Substantially all of this work is done directly through agents in the various foreign countries involved in contrast to handling the applications through American firms specializing in foreign practice.

3. Because of the volume of foreign work, it was necessary to set up a Foreign Department about 1956 with a secretary in charge. This secretary is instructed on and handles all phases of foreign application work, including obtaining export licenses in compliance with 35 USC 184 when required.

4. Mrs. Randee Seiger took charge of the Foreign Department about June 1969. She was given training by Mrs. Eloise Dana who had been in charge of the Foreign Department

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at an earlier date. Mrs. Dana continues to give advice and help as needed.

5. Mr. Paul D. Flehr and myself are the partners responsible for the Foreign Department.

6. Mrs. Seiger is an efficient and competent secretary and has handled the Foreign Department in a satisfactory manner.

7. On September 12, 1969, I dictated, signed and sent a letter to the assignee of the above-entitled application, a copy of which is attached hereto as Exhibit A, advising that the Convention period for filing corresponding foreign applications would expire on December 16, 1969. This is in accordance with our normal, customary procedure in which the attorney responsible for a particular client's work writes a so-called "Convention" letter to call attention to the necessity of filing corresponding foreign applications prior to expiration of the Convention period.

8. Responsive to the "Convention" letter, the assignee, Pacific Plantronics, Inc., by letter to me of October 9, 1969, authorized the filing of corresponding applications in Great Britain, Canada, Sweden, Germany, France and Spain. A copy of the authorization letter is attached hereto as Exhibit B.

9. The letter was referred to Mrs. Seiger who was instructed to file corresponding applications in the listed countries. It was assumed that Mrs. Seiger would take steps to obtain the required export license and prepare the necessary papers as customarily done by the Foreign Department.

10. Convention applications were mailed to our firm's foreign associates in the noted countries.

11. It has now come to my attention that Mrs. Seiger failed to obtain an export license pursuant to 35 USC 184.

12. Upon investigation, I found that this was the first

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design application processed by Mrs. Seiger and that it was Mrs. Seiger's understanding that export licenses were only necessary in connection with an application for utility patents, in which the Convention period is one year and that design patent applications, having a six month Convention period, were treated in the same manner as trademark applications filed under the International Convention where a license is not required.

13. As stated above, Mrs. Seiger is a competent and efficient secretary. She at no time has failed to obtain a license when required in connection with utility patent applications.

14. Therefore, to the best of my knowledge and belief, the failure to obtain the required license in this instance was due to inadvertence and was not intentional.

Aldo J. Test

Subscribed and sworn to before me this 3rd day of December 1969.

Notary Public

NANCY A. DAVIDSON
My Commission Expires Aug. 16th, 1971

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479A

EXHIBIT A

September 12, 1969

Pacific Plantronics, Inc.
P. O. Box 635
Santa Cruz CA 95060

Attention: Mr. William H. Schaumberg

Re: HUTCHINGS Design Application
for MICROPHONE AND RECEIVER
INSTRUMENT - Serial No. 17,718
Filed June 16, 1969
Our File DA-24547

Dear Bill:

The six month Convention period for filing foreign applications corresponding to the above will expire on December 16, 1969. This means that any foreign applications must be filed by then in order to receive a priority date as of the date of filing in the United States.

In the event you are interested in such applications, please let us have your authorization by about October 15, 1969. If we have not heard from you by that time, we will assume that you are not interested in filing corresponding foreign applications at this time.

Very tru' · yours,

FLEHR, HOHBACH, TEST,
ALBRITTON & HERBERT

Aldo J. Test

AJT/bjs

492

EXHIBIT B

PACIFIC
PLANTRONICS
INC.

FLEHR, HOHBACH, TEST,
ALBRITTON & HERBERT
1968 OCT 10 AM 9:47
RECEIVED

POST OFFICE BOX NO. 635
SANTA CRUZ, CALIF. 95060
TELEPHONE (408) 426-5858

October 9, 1968

Flehr, Hohbach, Test, Albritton & Herbert
160 Sansome Street
San Francisco, California 94104

Attention: Mr. Aldo J. Test

Re: Hutchings Design Application for
Microphone and Receiver Instrument -
Serial No. 17,718, Filed June 16, 1969
Your File DA-24547

Dear Al:

Please file foreign applications of the above in Great Britain, Canada, Sweden, Germany, France, and Japan.

Very truly yours,

PACIFIC PLANTRONICS, INC.

W H Schaumberg

W. H. Schaumberg
Chief Engineer

WHS:mg

. wherever communications are impr g

493

PLAINTIFF'S
EXHIBIT
74 2

480

IN THE UNITED STATES PATENT OFFICE

In re application of)
KENNETH J. HUTCHINGS)
Serial No. D 17,718)
Filed: 16 June 1969)
For: MICROPHONE & RECEIVER INSTRUMENT)

A F F I D A V I T

STATE OF CALIFORNIA)
CITY &) ss
COUNTY OF SAN FRANCISCO)

I, RANDEE C. SEIGER, being duly sworn, hereby state that:

1. I am employed as a secretary in the firm of Flehr, Hohbach, Test, Albritton, & Herbert, attorneys of record in the above-entitled application, from June 20, 1969 to the present.

2. I was hired to assume the responsibility of processing foreign patent and trademark applications and amendments thereto, through various foreign agents. This is known as the Foreign Department of the firm.

3. In connection with my duties, I learned of the requirement for an export license for filing a foreign utility patent application before the expiration of six months. It was my belief that design applications, having a six-month Convention period, were of necessity filed within six months of the date of the United States application and therefore exempt from the requirement of an export license. I had not processed any design applications previous to the foreign applications based on the above and did seek instruction as to the proper forms and papers required by each foreign country involved. The necessity of an export license, however, was not discussed.

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4. I have read the affidavit of Aldo J. Test, Esq., and to the best of my knowledge the facts stated therein are true.

5. Applications for design patents based on the above were forwarded to agents in Canada, France, Germany, Great Britain, Japan and Sweden on or about November 18, 1969, for filing before expiration of the Convention period.

6. Since the Convention period will expire on December 16, 1969, it is believed that corresponding foreign applications have been filed by our associates in the listed countries.

7. I inadvertently and unintentionally forwarded the papers without making application for an export license.

Randee C. Seiger

Subscribed and sworn to before me
this 3rd day of December 1969.

Notary Public

NANCY A. DAVIDSON
My Commission Expires Aug. 16th, 1971

495

JAN 5 1970

RECEIVED JAN 15 1970

GROUP 290

Reuben J. Jenkins 2/3/70

IN THE UNITED STATES PATENT OFFICE

In re application of	
KENNETH J. HUTCHINGS	Examiner: Bernard Ansher
Serial No. 17,718	Group No. 291
Filed: June 16, 1969	Paper No. 3
For: MICROPHONE AND RECEIVER INSTRUMENT	

San Francisco, California

December 31, 1969

CHIEF DRAFTSMAN

Commissioner of Patents

Washington, D. C. 20231

Sir:

Subject to the approval of the Examiner, change all broken lines appearing in the drawing of the above identified application to full lines.

Also change the fragmented tubular ends so that they are finished off in all views.

The cost of the foregoing is to be charged against the account of Flehr, Hohbach, Test, Albritton & Herbert Account No. 06-1300 (Order No. DA-24547).

Respectfully submitted,

FLEHR, HOHBACH, TEST, ALBRITTON & HERBERT

By Aldo J. Test

Telephone: (415) 781-1989

1970

496

PLAINTIFF'S

PLAINTIFF'S

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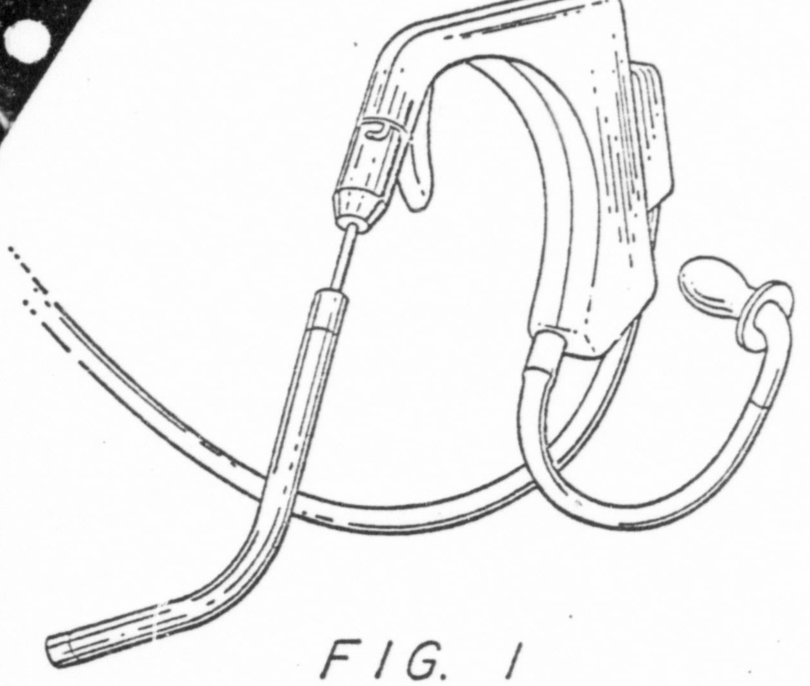

FIG. 1

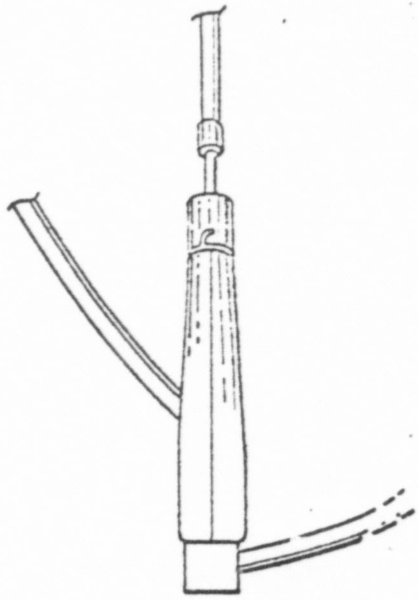

FIG. 4

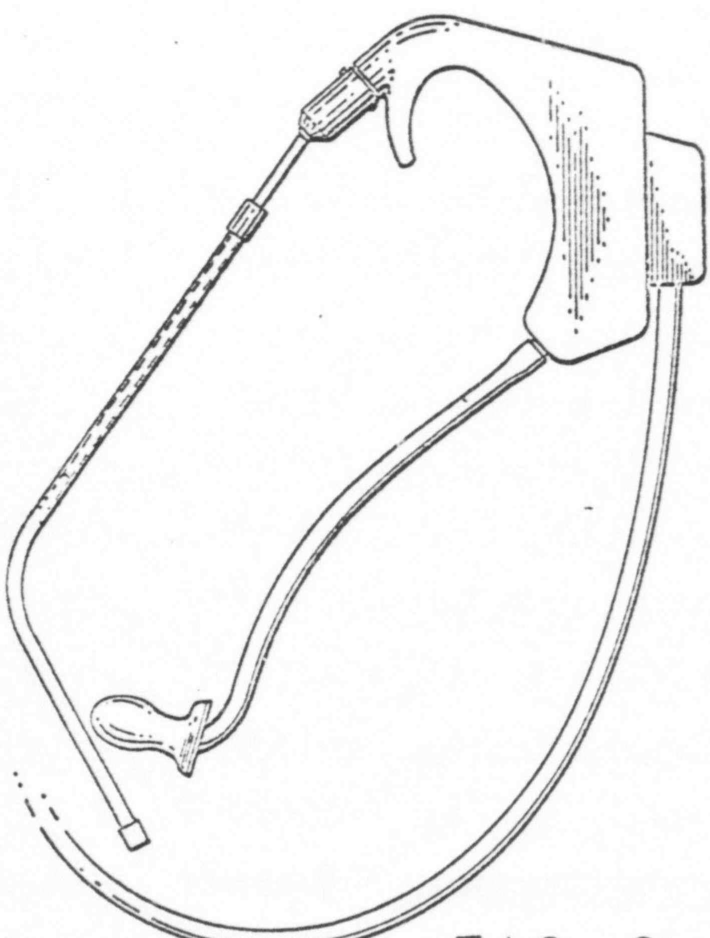

FIG. 2

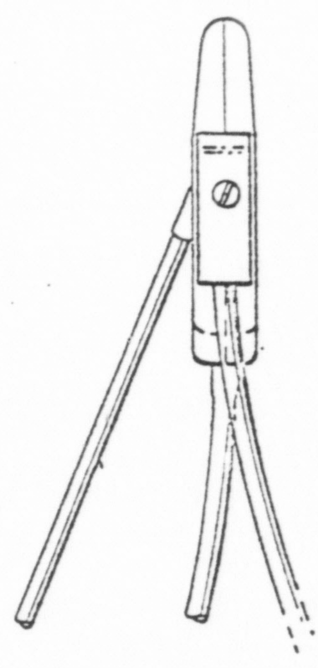

FIG. 3

INVENTOR
KENNETH J. HUTCHIN
BY Flehr, Hohbach, Test Albritton & Herbert
ATTORNE

497

PLAINTIFF'S

IN THE UNITED STATES PATENT OFFICE

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN that I, KENNETH J. HUTCHINGS, a citizen of the United States of America, residing in Soquel, California, have invented a new, original and ornamental design for a MICROPHONE AND RECEIVER INSTRUMENT of which the following is a specification, reference being had to the accompanying drawing, forming a part hereof, wherein:

FIGURE 1 is a perspective view of the MICROPHONE AND RECEIVER INSTRUMENT;

FIGURE 2 is a side elevational view of the MICROPHONE AND RECEIVER INSTRUMENT;

FIGURE 3 is a back elevational view of the MICROPHONE AND RECEIVER INSTRUMENT; and

FIGURE 4 is a top elevational view of the MICROPHONE AND RECEIVER INSTRUMENT.

I CLAIM:

The ornamental design for a MICROPHONE AND RECEIVER INSTRUMENT.

/s/ Kenneth J. Hutchings
Kenneth J. Hutchings

485

Washington, D.C. 20231

MAILED

JAN 26 1970

U. S. PATENT OFFICE

#4

LICENSE FOR FOREIGN FILING

(Title 35, United States Code (1952) Sections 184, 185, 186)

FLEHR, HOHBACH, TEST, ALBRITTON
AND HERBERT
160 SANSOME ST.
SAN FRANCISCO, CALIF. 94104

U.S. Serial No. D 17,718
Filed: June 16, 1969
Inventor: Kenneth J. Hutchings
Title: MICROPHONE AND RECEIVER INSTRUMENT

License under 35 U. S. C. 184 is hereby granted to file in any foreign country a patent application and any amendments thereto corresponding to the subject matter of the U. S. application identified above and/or any material accompanying the petition. ~~This license is conditioned upon modification of any applicable secrecy order and is subject to revocation without notice.~~ This license is made retroactive to November 18, 1969 with respect to Canada, France, Germany, Great Britain, Japan and Sweden.

LICENSE NO. 337645 APPROVED

Date JAN 1970

DIRECTOR

COMMISSIONER OF PATENTS

This license empowers the filing, the causation and the authorization of the filing of a foreign application or applications on the subject matter identified above, subsequent forwarding of all duplicate and formal papers and the prosecution of such application or applications.

This license does not empower the filing of any applications, amendments, supplements or continuances originating in this country which disclose inventions, modifications, or variations not disclosed in the subject matter identified above.

This license is to be retained by the licensee and may be used at anytime on or after the date thereof. This license is not retroactive unless specifically indicated.

The grant of this license does not in any way lessen the responsibility of the licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations, especially with respect to certain countries, of other agencies, particularly the Office of Munitions Control, Department of State (with respect to Arms, Munitions and Implements of War); and the Bureau of International Commerce, Department of Commerce.

FORM PO-280 (5-69) USCOMM-DC 51394-P69

499

486

U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON, D. C. 20231

Exam Ans

Paper No. 5

Mailed

Reply Please Refer To The Following:

EXAMINER'S NAME	Bernard Ansher	
291	June 16, 1969	D-17718
GR. ART UN.	FILING DATE	SERIAL NO.
Kenneth J. Hutchings		
APPLICANT		INVENTION
A MICROPHONE AND RECEIVER INSTRUMENT		

MAILED
MAR 3 1970
GROUP 250

Flehr, Hohbach, Test, Albritton
and Herbert
160 Sansome Street
San Francisco, Calif. 94104

Please find below a communication from the EXAMINER in charge of this application.

Commissioner of Patents

CHANGES AND/OR ADDITIONS TO THE APPLICATION RECORD MADE BY THE EXAMINER UPON ALLOWANCE

This application is in condition for allowance and the following changes have been made therein by the Examiner. Should the changes be unacceptable to applicant, an appropriate amendment may be proposed *after the Notice of Allowance has been received, as provided under Rule 312.*

To ensure consideration of such an amendment, it should be submitted on or before remittance of the Minimum Issue Fee.

PROSECUTION ON THE MERITS IS CLOSED. A NOTICE OF ALLOWANCE WILL BE MAILED IN DUE COURSE.

In order to direct your claim to a unitary article of manufacture as required under the provisions of 35 USC 171, the title has been uniformly amended throughout the papers to read:

--A Combined Microphone and Receiver Instrument.--

Bernard Ansher
BERNARD ANSHER

EXAMINER

BAnsher/vg

PLEASE FURNISH YOUR ZIP CODE IN ALL CORRESPONDENCE

FORM POL-37 (REV. 1-69)

500

487

U.S. DEPARTMENT OF COMMERCE
Patent Office

Address Only: COMMISSIONER OF PATENTS
Washington, D.C. 20231

Paper No.:

Serial No.:

EXAMINER(S) NAMED IN ALLOWED APPLICATION

Below are listed the names of the examiners who acted in this allowed application. Their names shall appear on the printed copies of the patent in the following order:

BERNARD ANSHER	Primary Examiner (Issuing Application)
	Examiner(s) (Signatory: Full or Partial)
	Assistant Examiner(s) (non-Signatory)

FORM PO-511 (11-69)

USCOMM-DC 50423-P69

501

United States District Court

for the

S.D.N.Y.

~~SSIONER OF~~ PATENTS,
Washington 25, D. C.

NYC

SOLICITOR
MAY 2 - 1972
U.S. PATENT OFFICE

In compliance with the Act of July 19, 1952 (66 Stat. 814; 35 USC 290), you are advised that there was filed on the 20th day of APRIL, 19 72, in this Court an action, No. 72 Civ 1625, entitled:

, Plaintiff,

Name PACIFIC PLANTRONICS

Address 111 JOSEPHINE STREET, SANTA CRUZ, CALIFORNIA 95060

versus

, Defendant,

Name ROANWELL CORPORATION

Address 180 VARICK STREET, N.Y.C. N.Y.

brought upon the following patents:

PATENT NO.	DATE OF PATENT	PATENTEE
1. 3,184,556	MAY18th, 1965	PLTFF
2. DES. 218,173	JULY 28th, 1970	PLTFF.
3. 3,548,118	DEC 15th, 1970	PLTFF.
4.		
5.		

In the above-entitled case, on the day of , 19 , the following patents have been included by (insert amendment, answer, cross bill, or other pleading) :

PATENT NO.	DATE OF PATENT	PATENTEE
1.		
2.		
3.		
4.		
5.		

In the above-entitled case the following decision has been rendered or judgment issued:

JOHN LIVINGSTON
Clerk.

Date APRIL 21, 19 72

By JAMES L. NUGENT
Deputy Clerk.

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C. 20231

U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON, D. C. 20231

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

DESIGN PATENT APPLICATION
NOTICE OF ALLOWANCE AND ISSUE FEE DUE

The application for Design Patent identified below has been examined and found allowable for issuance of Design Letters Patent.

	FILING DATE 06/16/69	SERIAL NUMBER 017718	291
APPLICANT	Hutchings, Kenneth J.; Soquel, Calif.		MAILED Apr. 8, 1970 smc
DESIGN FOR	Combined microphone and receiver instrument		
	SHEETS OF DRG 001	CLASS/SUB D26/014.	

With the allowance of the application, the issue fee becomes due. Design letters patent are granted for the terms of either 3½, 7, or 14 years, and the issue fees therein are $10, $20, and $30, respectively. **Failure to remit the issue fee and notify the Office as to the elected term within three months from the mailing date hereof shall result in abandonment of the application.** (35 USC 151)

The issue fee will not be received from anyone other than the applicant, his assignee or attorney, or a party in interest as shown by the records of the Patent Office. A form is enclosed relating to the address of the inventor(s) which requires your attention.

If it is desired to have the patent issued to an assignee or assignees, an assignment, together with the fee for recording the same must be filed in this Office on or before the date of payment of the issue fee.

The patent will be issued and forwarded in due course after receipt of the issue fee.

By direction of the Commissioner.

Flehr, Hohbach, et al
1?? Sansome Street
San Francisco, Calif. 94104

B.B.

503

U.S. PATENT OFFICE APR 27 1970

...provided for ... in transmitting Issue Fees to the Patent Office. When properly completed it may be used in lieu of a formal transmittal ... fill in items numbered 1 thru 5 below. The Issue Fee Receipt, in all cases, will be mailed to the address appearing in box ... Form. If desired use the reverse side of your Notice of Allowance for carbon copy when completing this form.

The COMMISSIONER OF PATENTS is requested to apply the accompanying fee to the case identified below, and deliver the patent as indicated.

FLEHR, HOHBACH, TEST, ALBRITTON & HERBERT

APRIL 22, 1970
Date

Attorney ... or Applicant

By: Aldo J. Test

NOTE—Issue Fees will not be received from other than the applicant, his assignee, or attorney, or a party in interest as shown by the records of the Patent Office. Issue Fees will not be applied to pending applications.

APR-28-70 138597 B 14 — CK 30.00

	FILING DATE	SERIAL NUMBER	
	06/16/69	017718	291
APPLICANT	Hutchings, Kenneth J.; Soquel, Calif.		MAILED Apr. 8, 1970 smc
DESIGN FOR	Combined microphone and receiver instrument		
	SHEETS OF DRWG	CLASS/SUB	
	001	D26/014.	

2. Assignee:

PACIFIC PLANTRONICS, INC.

3. ELECTED TERM (IN YEARS)

☐ 3½ ($10) ☐ 7 ($20) ☒ 14 ($30)

AMOUNT ENCLOSED $30.00

MAILING INSTRUCTIONS

NOTE—The office will send the patent to the address entered in stub at left below unless you direct otherwise. Use the spaces provided to indicate any changes which affect the delivery of the patent. Please furnish the recipient's zip code.

4. Do not send the patent to the addressee entered on the reverse side of this form. Send patent to (check one)

☐ Patentee

☐ Associate Attorney (See specific authorization in file)

☐ Assignee

☐ Change of address—Attorney

The address of the person checked above is typed in Item 5 below.

5. Include Zip Code

504

...96 COMPLETE SPECIFICATION

SEARCHED

	Class	Sub	Date	Ex'r
D-	26	14 (14.7)	10-15-69	B.A
	179	156	10-16-69	B.A
	181	23	"	BA

LAFAYETTE ELECT. CAT. BOX
ALLIED ELECT. CAT. BOX (290)
SEARS - 1965 - 1968
WARDS - 1967 - 1969
JAPAN ELECTRONIC BUYERS' GUIDE - 1964 - 1968

EMBODIMENTS FILED	ISSUED

INTERFERENCE SEARCHED

	Class	Sub	Date	Ex'r
D-	26	ALL	3-12-70	B.A.

505

3 A. 639

70

CONTENTS

MAR 3 1970

BM QUALITY CONTROL

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Bell Model 61 Sales 1970 - 1974

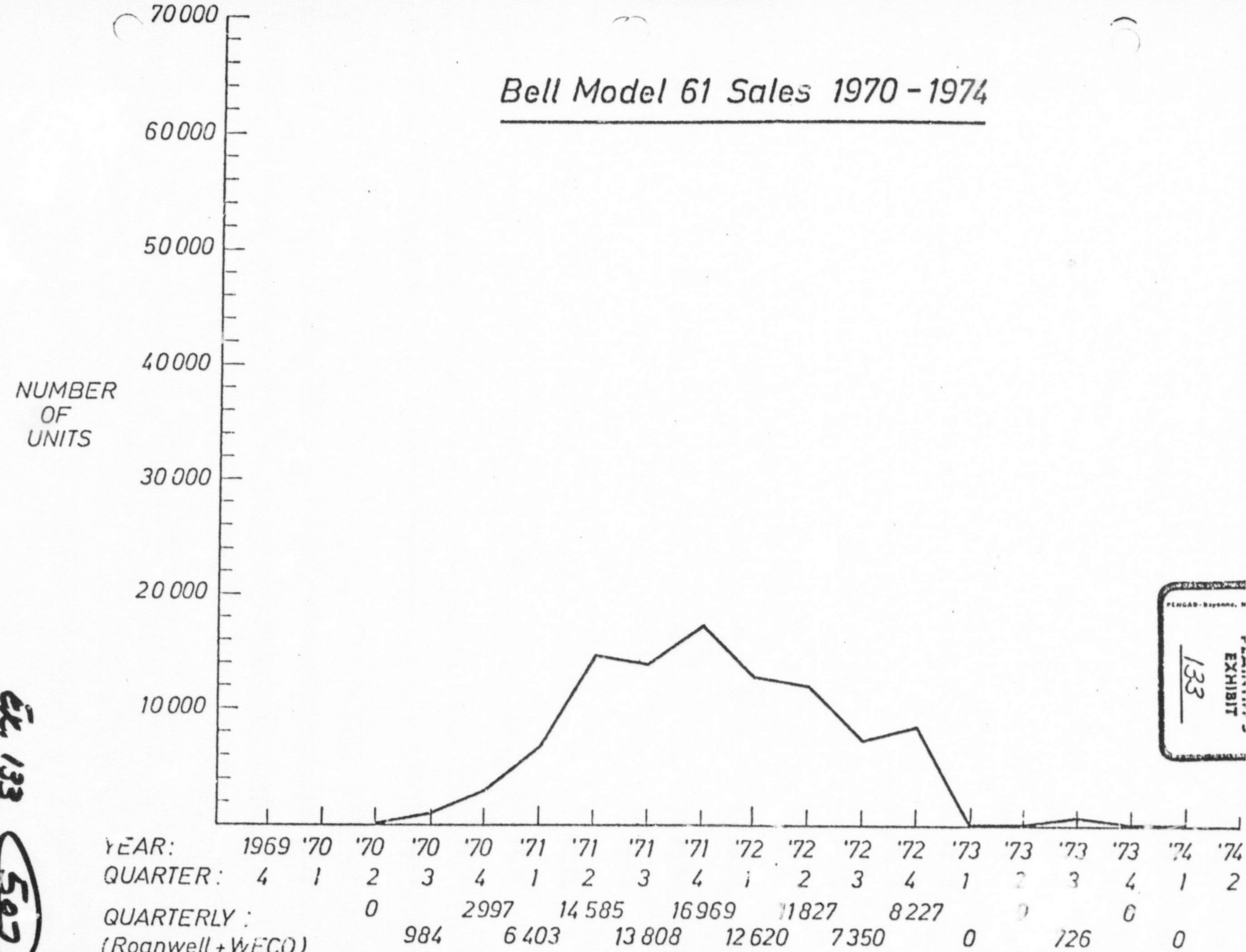

EXHIBIT 133

Ex. 133

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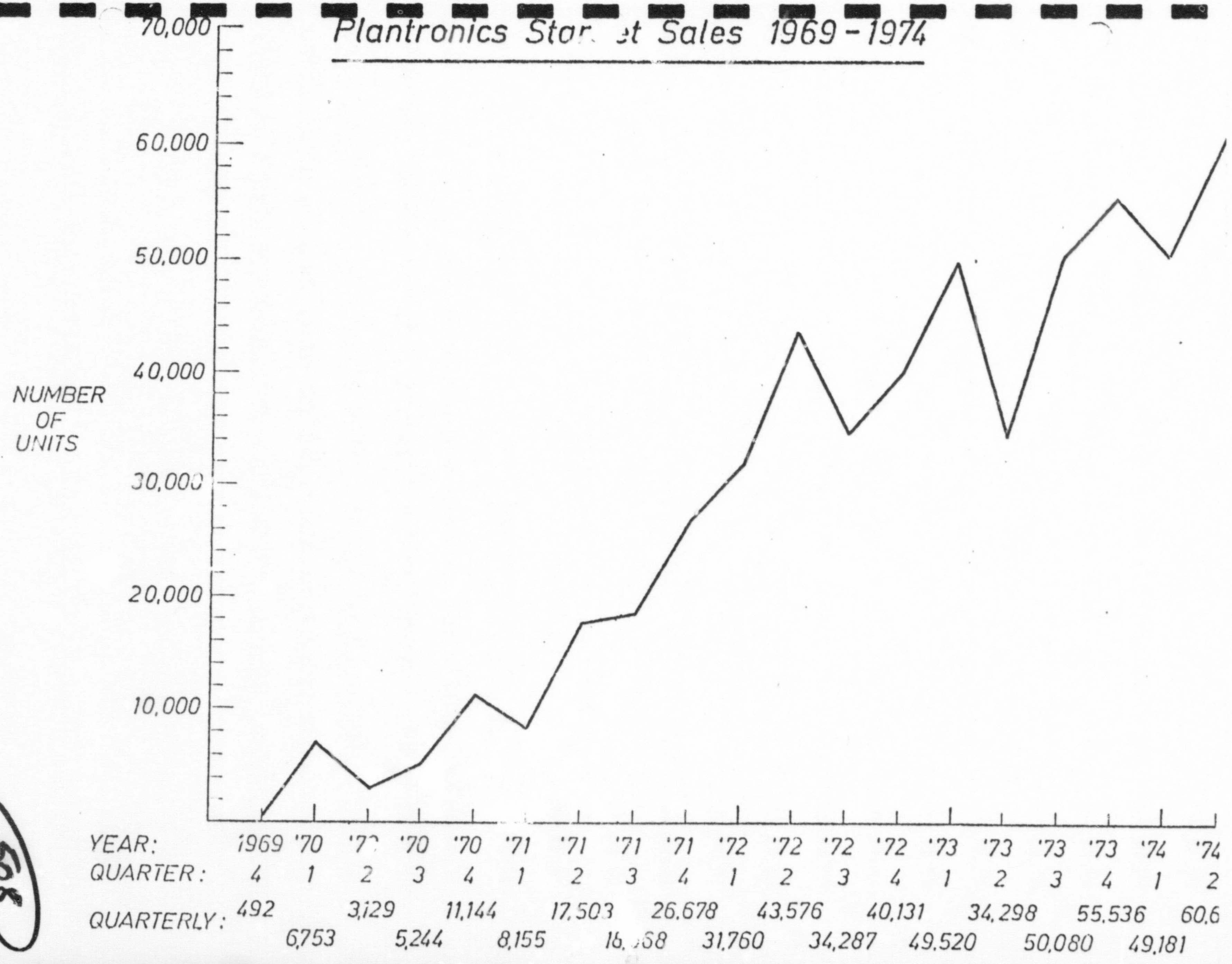

Plantronics Star. .t Sales 1969 - 1974
NUMBER OF UNITS
70,000
60,000
50,000
40,000
30,000
20,000
10,000
YEAR: 1969 '70 '7? '70 '70 '71 '71 '71 '71 '72 '72 '72 '72 '73 '73 '73 '73 '74 '74
QUARTER: 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2
QUARTERLY: 492 6,753 3,129 5,244 11,144 8,155 17,503 16,.68 26,678 31,760 43,576 34,287 40,131 49,520 34,298 50,080 55,536 49,181 60.6

508

PENGAD-Bayonne, N.J.
PLAINTIFF'S
EXHIBIT
Photo of
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Ex. 134

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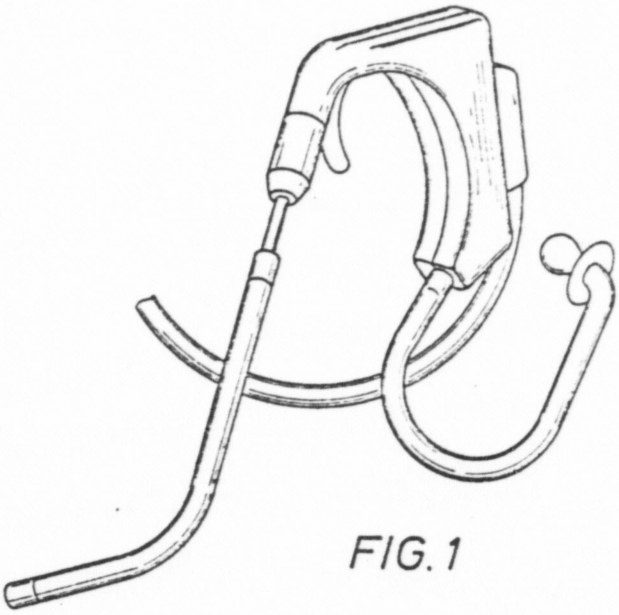
HUTCHINGS

PLAINTIFF'S EXHIBIT 135

Roanwell R-70



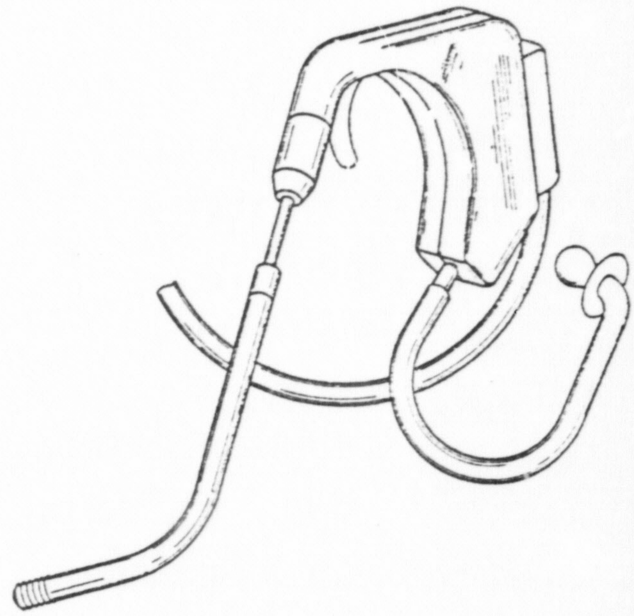
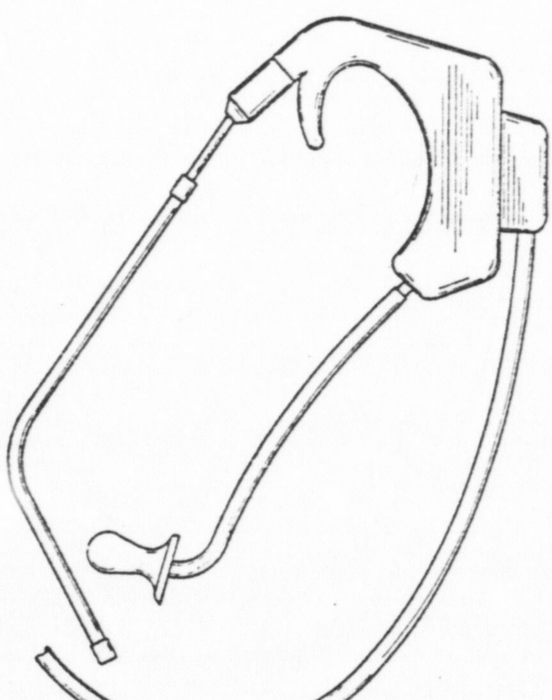


FIG.1



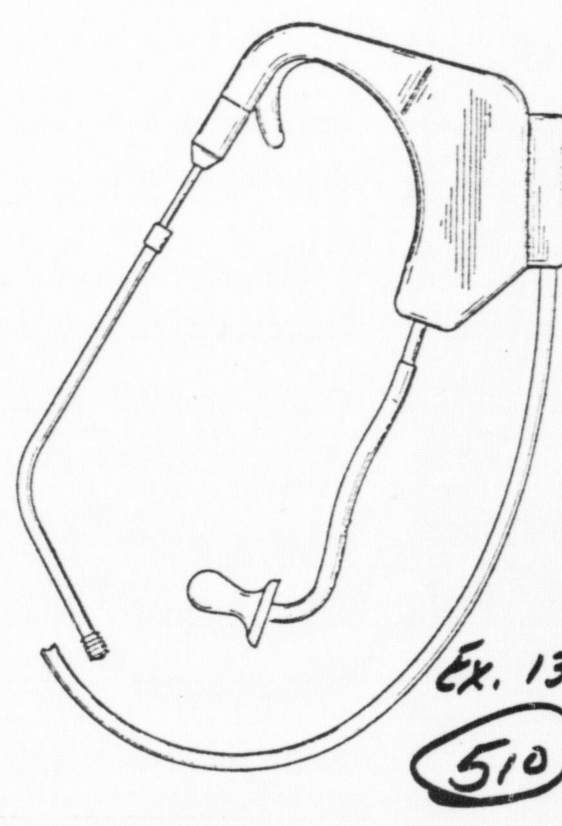


FIG.2

Ex. 135

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LARKIN, Claim 1

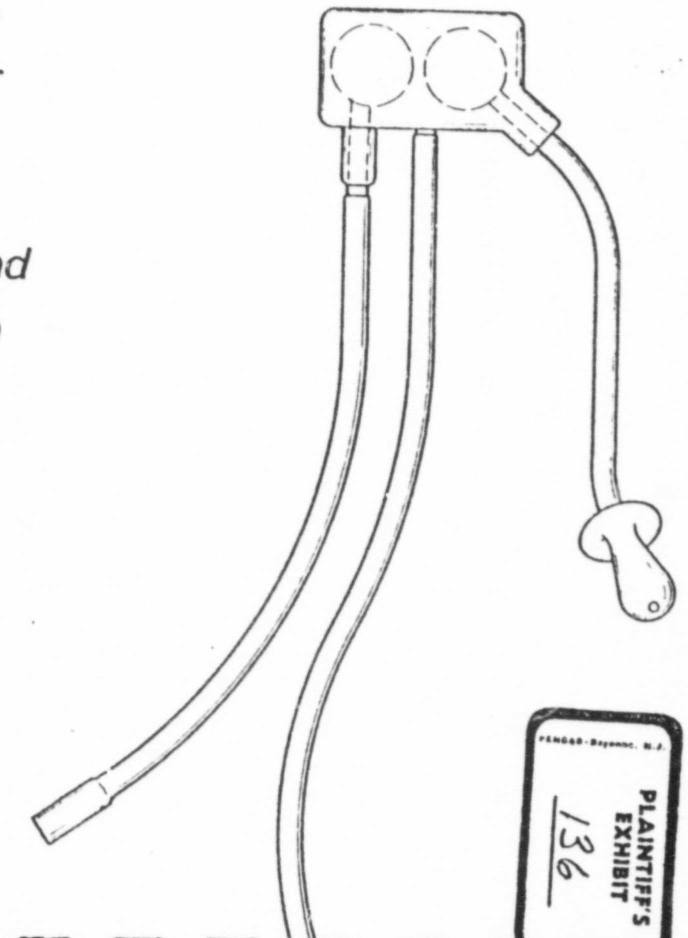
Plantronics MS-50

1. A miniaturized microphone headset employing a miniature microphone and a miniature receiver, comprising the combination of

support means for detachably supporting the miniature microphone and the miniature receiver adjacent to the wearer's ear,

a first acoustical tube, means for attaching one end of said first tube to said microphone and the other end of said first tube being adapted to be positioned adjacent to the wearer's mouth,

a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear.



PLAINTIFF'S EXHIBIT 136

Ex. 136

511

PLAINTIFF'S EXHIBIT

137

Roanwell Acoustics Laboratory Report
of Nov. 8, 1962
"Analysis of Plantronics Headsets"

"The Plantronics MS-50 headset microphone may well be one of the first of a new generation of headsets...

"It seems that Plantronics has come up with a combination of

user comfort,

low weight,

high versatility, and

adequate voice transmission

which has gained them appreciable acceptance (Project Mercury) in a relatively short time."

Ex. 137 (512)

PATENT SPECIFICATION

Inventor: JAMES SAMUEL PATERSON ROBERTSON

776,896

PLAINTIFF EXHIBIT 138

Date of Application and filing Complete Specification April 29, 1955.

No. 12509/55.

Complete Specification Published June 12, 1957.

EXAMINER'S ... 16.

Index at acceptance :—Classes 13, 13(C: G); and 40(4), J(1A: 1B: 3A: 3E: 3R: 4B: 4D).

International Classification : —C10k. H04m.

COMPLETE SPECIFICATION

Improvements in or relating to Operator's Telephone Headsets

We, STANDARD TELEPHONES AND CABLES LIMITED, a British Company, of Connaught House, 63 Aldwych, London, W.C.2, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to operators' telephone headsets. According to one aspect of the invention, there is provided an operator's telephone headset comprising an acoustic wave transmission column which is adapted to pass acoustic waves from the mouth towards a telephone transmitter carried by a headband, and which includes a detachable and rotatable horn carried by the transmitter casing.

According to another aspect of the invention, there is provided an operator's telephone headset comprising an acoustic wave transmission column for passing acoustic waves from the atmosphere towards the telephone transmitter which is carried by a headband, the column including a curved horn terminating at its smaller end in a cylindrical collar, which forms a push-fit with a cylindrical connecting-piece terminating an acoustic channel extending from the transmitter casing. The cylindrical collar being capable of rotation on the connecting-piece.

The invention will now be described with reference to the accompanying drawings in which:—

Fig. 1 is a general view of the set,

Fig. 2 shows the set partly dismantled,

Fig. 3 shows parts of the set after further dismantling.

Referring to Figs. 1—3, the transmitter assembly 1 and the receiver assembly 2 are carried by a base 3 and held in position by a flexible strap 4. A cover 5 encloses both assemblies. A pad 6 is carried by a headband 7 mounted by means of a ball 8 on the cover 5. An exponential horn 9 terminates in a collar 10 mounted on a connecting piece 11. The connecting piece 11 is adjustably mounted on an angle-piece 12 which is rotatably mounted on the base 3. The leads to the transmitter and receiver are carried in a cord 13 which passes through an aperture in the cover 5.

The angle piece 12 can be rotated through 180° from the position shown in the drawings. The collar 10 of the horn 9 can rotate around the connecting piece 11. By rotating the angle piece 12 and the horn 9 through 180° the set may be worn with equal convenience on either ear. The connecting piece 11 engages the angle-piece 12 in a flexible joint which permits the position of the horn 9 to be adjusted to suit the user. A ball-and-socket joint is used to connect the headband 7 to the cover 5 at the aperture 54. The connection at this joint is therefore also adjustable The angle piece 12 is mounted on the base 3 below the receiver assembly 2. By moving the base 3 pendulum fashion about the ball-and-socket joint, the angle-piece 12 can be moved forward of or behind a vertical line passing through the centre of the receiver assembly 2. In this way the set can be adjusted to suit the distance between the ear and the mouth of any particular user.

The cover 5 is held to the base 3 by a lug 14, which engages with a stud 15, and by two screws 16. The head of each screw 16 is accommodated in a recess 17 on the outer surface of the cover 5. The shank of the screw 16 is held by a pillar 18 embossed on the inner surface of the cover 5. Each screw 16 engages with a hole 19 tapped in a ring 20, which is attached to the base 3 by a number of studs 21. The heads of the studs 21 are expanded rivet-fashion to hold the ring 20.

The studs 21 have a ledge 22 on the inner surface. The receiver assembly 2 rests on these ledges. The receiver assembly 2 is held in position by the flexible strap 4 which is secured to the ring 20 by three screws 23 engaging in tapped holes 24. Holes 25 in the strap 4 permit the passage of the screws 23. Two further holes 26 permit the terminals 27 of the receiver assembly 2 to pass through the strap 4.

[*Price 3s. 6d.*]

Ex. 138 513

To carry the transmitter assembly 1, two pillars 28, each with a ledge 29, are provided on the base 3. A third ledge 30 is also provided for this purpose. The ledge 30 is part of the outer surface of a hollow column 31 which is formed integrally with the base 3. The hollow core of the column 31 acts as part of the acoustic channel 39 leading from the horn 9. A hole 32 is provided in the column 31 at a position which is suited to the position of the microphone in the transmitter assembly 1. The hole 32 is surrounded by a rim 58 which serves as a seating for a polyvinylchloride washer (not shown) or similar resilient member which ensures an acoustically tight joint, when the transmitter assembly is in position. At the foot of the column 31, an inset 33 is held by two screws 34, the heads of which are expanded rivet-fashion. The inset 33 carries a tapped hole 35. The transmitter assembly 1 is held in position by the strap 4, the lower portion of which is secured by a screw 36 which passes through a hole 37 in the strap 4 to engage in the tapped hole 35 of the inset 33. When the screw 36 is tight, the strap 4 holds the transmitter assembly 1 with sufficient force to ensure a substantially acoustically tight joint at the hole 32. To assist in making a tight joint, a washer (not shown) is provided at the hole 32. To isolate the transmitter assembly acoustically from the base 3, the transmitter assembly carries an annular cushion (not shown) which bears on the ledges 29, 30. The transmitter assembly 1 has two terminals 38 to which the cord 13 is connected.

By undoing the appropriate screws 23, 36, the transmitter assembly 1 and the receiver assembly 2 can be removed from the base 3 independently of each other.

The horn 9 is connected to the base 3 by the connecting piece 11 and the angle-piece 12. Each piece has a hollow central bore forming part of acoustic channel 39 connecting the horn 9 to the microphone of thr transmitter assembly 1. The connecting piece 11 and the angle-piece 12 are held in their working positions by a helical spring (not shown) which is accommodated within the acoustic channel 39. One end of the spring is anchored to a cap 40 provided at the top of the column 31, a polythene washer 57 being provided between the cap 40 and the column 31 to ensure an acoustically tight joint. The other end of the spring is anchored to a washer 41 at the outer end of the connecting piece 11. The tension of the spring keeps the connecting piece 11 and the angle-piece 12 in position. Within the angle-piece 12, the acoustic channel 39 is composed on straight bores. If a uniformly curved bore is used, the spring acquires a bias resulting in an uneven action of the joint between the connecting piece 11 and the angle-piece 12 and in a reduction of pressure at one side of the joint between the angle-piece 12 and the base 3 to a value insufficient to keep the joint acoustically tight. The horn 9 is held in position by the friction between its collar 10 and the connecting piece 11 which the collar 10 fits closely. The presence of the spring within the acoustic channel 39 gives rise to acoustic damping and reduces the amplitude of standing waves which occur at certain frequencies.

The bearing surface of the angle-piece 12 against the base is provided with two cams 42 set 180° apart. The cams 42 engages with two recesses (not shown) provided at the foot of the column 31 in the base 3. The angle-piece 12 has therefore two stable positions, 180° apart, in relation to the base 3, in each of which the cams 42 engage in the recesses. A small clearance is allowed between the tops of the cams 42 and the bottoms of the recesses. This ensures that the pull-action of the spring is taken by the main bearing surfaces of the angle-piece 12 and of the base 3 so as to secure a substantially acoustically tight joint. The angle-piece 12 is provided with a fin 43, which comes into contact with the outer surface of the base 3 if an attempt is made to rotate of the angle-piece 12 beyond 180° from the position shown in the drawings. The face of the fin 43 which comes into contact with the surface of the base 3 is so inclined that, if rotation is continued beyond 180°, the angle-piece 12 is forced downward against the action of the helical spring in the acoustic channel 39. The check action thereby obtained is gradual and less likely to give rise to breakages than the positive action of a buffer stop. The check action also serves to discourage continuous rotation of the angle-piece 12 in one direction and to prevent the deleterious effect on the spring which such rotation would have.

The other end of the angle-piece 12, is indented to provide a seating 59 for a polythene washer 60. The seating 59 and the outer surface 61 of the washer 60 are in the shape of the frustrum of a cone. The inner surface 44 of the washer 60 is part of a sphere.

Under the influence of the helical spring, the connecting piece 11 beds against the surface 44 of the washer 60 and provides a substantially acoustically tight joint between the angle-piece 12 and the connecting piece 11.

At one end of the connecting piece 11 is a surface 45 which bears on the surface 44 of the washer 60. The surface 45 is formed from a hemisphere, part of which is cut away for the acoustic channel 39. The joint between the connecting piece 11 and the angle-piece 12 can therefore function as a ball-and-socket joint while remaining substantially acoustically tight. The angle of the horn 9, which depends on the position of the connecting piece 11, can therefore be varied without impairing the efficiency of the acoustic channel 39.

The surface 45 terminates in a shoulder 46. At the other end of the connecting piece 11 is a flat bearing surface 47 for the polythene washer 48, which is held in position by the

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action of the spring (not shown) on the washer 41.

The exponential horn 9 is made of nylon which will regain its shape after accidental deformation. The shape of the horn 9 is determined by the type of microphone used in the transmitter assembly 1 and is such as to give increasing efficiency above the frequency at which the efficiency of the mircophone begins to decrease. The horn 9 has a collar 10 enclosing a hollow brass inset which fits on to the connecting piece 11 and abuts the shoulder 46. The collar 10 and the connecting-piece 11 are dimensioned to give a push-fit. The action of the spring tends to make the connecting-piece 11 barrel shaped and so ensures adequate frictional contact. The joint is made acoustically tight by the washer 48.

The washers 48, 57 and 60 are made of polythene which has approximately the same coefficient of friction under static and moving conditions. The position of the horn 9 can therefore be varied without jerks.

On the inside of the cover 5 an inset 49, in the shape of a hollow square is carried by four studs 50, the heads of which are expanded rivet-fashion. A V-piece 51 is carried on the inset 49 by two screws 52. At the apex of the V is a socket 53 which receives the ball 8 of the headband 7 which penetrates the cover 5 at the aperture 54. The V-piece 51 is resilient and forces the ball 8 into contact with another socket (not shown) on the inner surface of the cover 5. The inset 49 clamps a piece of soft material 55 against the inner surface of the cover 5. The piece of soft material 55 prevents the entry of dust through the aperture 54. A short length of fine cord 56 is tied at one end to the inset 49 and at the other end to the cord 13, to act as a stain cord.

By using the construction described above, it is possible to effect an appreciable reduction in the weight of the operator's telephone headset. While conventional sets may weigh as much as 15½ ozs, a set constructed as described above weighs only 4 ozs.

What we claim is:—

1. An operator's telephone headset comprising an acoustic wave transmission column which is adapted to pass acoustic waves from the mouth towards a telephone transmitter carried by a headband and which includes a detachable and rotatable horn carried by the transmitter casing.

2. An operator's telephone headset comprising an acoustic wave transmission column, for passing acoustic waves from the atmosphere towards the telephone transmitter which is carried by a headband, the column including a curved horn terminating at its smaller end in a cylindrical collar, which forms a push-fit with a cylindrical connecting-piece terminating an acoustic channel extending from the transmitter casing, the cylindrical collar being capable of rotation on the connecting-piece.

3. An operator's telephone headst comprising an acoustic wave transmission column as claimed in Claim 2, wherein the cylindrical connecting-piece is carried by an angle-piece, is separate from the transmitter casing, and is carried thereby and held thereto by a helical spring which passes through the connecting-piece, the angle-piece and a passage in the transmitter casing, and which is anchored at both ends.

4. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 3, wherein the angle-piece terminates in cam-extensions, which engage in complementary cam-recesses at the end of the passage in the transmitter casing; so that the knee-joint can be rotated between two positions 180° apart, in each of which positions the cam-extensions and the cam-recesses are in engagement, movement between said positions being possible by rotating said angle-piece around the axis of said passage in the transmitter casing and disengaging said cam-extensions and cam-recesses during rotation.

5. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 3, wherein the angle-piece carries a fin having an inclined face so sloped as to oppose rotation of the angle-piece between said two positions via one half-circle, and thereby to prevent the internal helical spring being continuously wound in the same direction.

6. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 5, wherein the acoustic passage in the angle-piece has a sharp turn to prevent imparting a bias to the helical spring, which would impair the action of the spring.

7. An operator's telephone headset comprising an acoustic wave transmission column as claimed in any of Claims 3—6, wherein the cylindrical connecting-piece has a rounded termination at one end, said termination engaging a co-operating recess at the end of the angle-piece, to form a ball and socket joint.

8. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 7, wherein the other end of the cylindrical connecting-piece carriers a resilient washer, held in place and compressed by a rigid washer, to which one end of the helical spring in achored, said resilient washer constituting an acoustic seal between the horn collar and the connecting-piece.

U. JOHN PRIOR,
Chartered Patent Agent,
For the Applicants.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1957.
Published at the Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

776,896 COMPLETE SPECIFICATION
3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

FIG. 1.

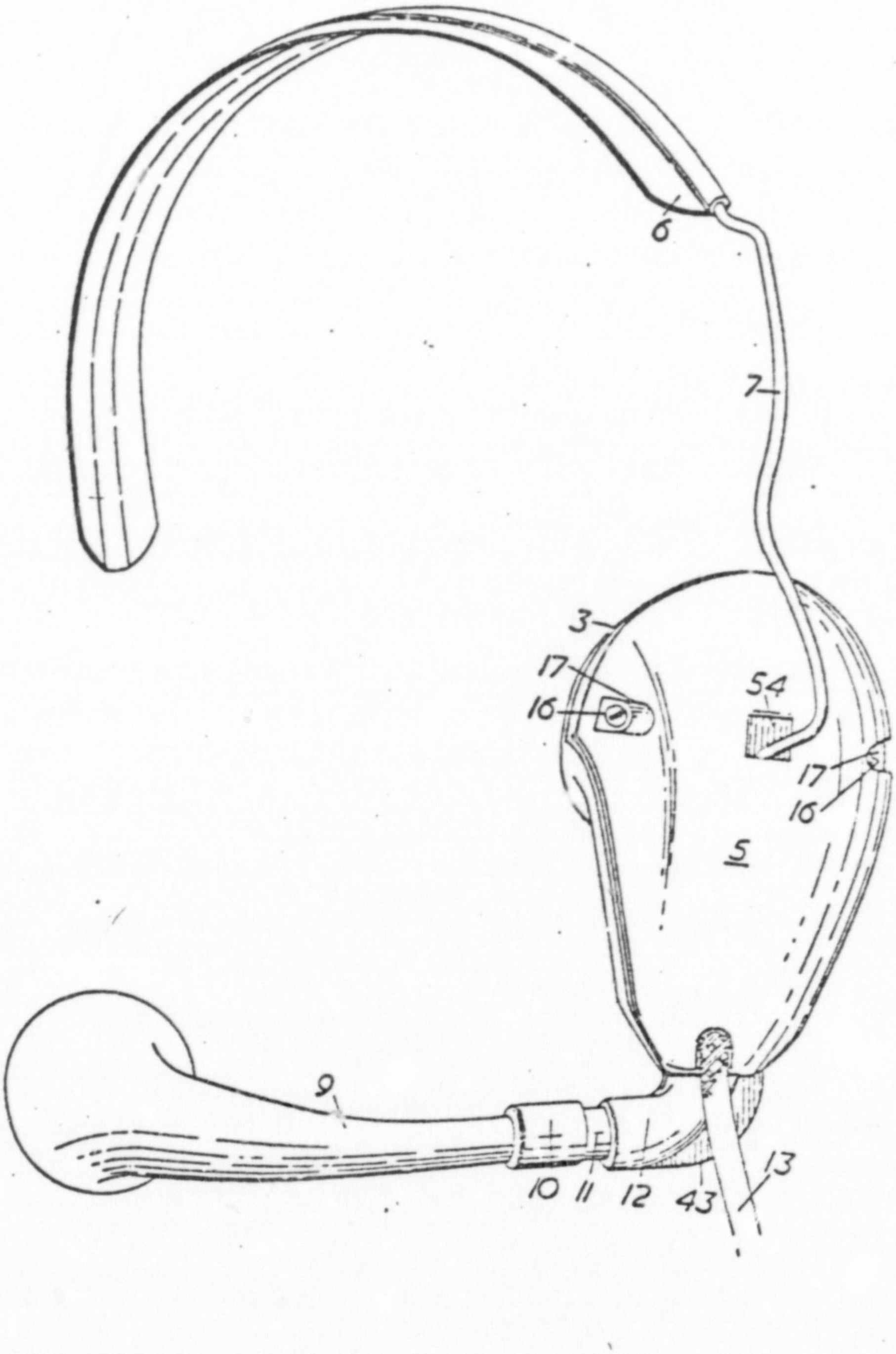
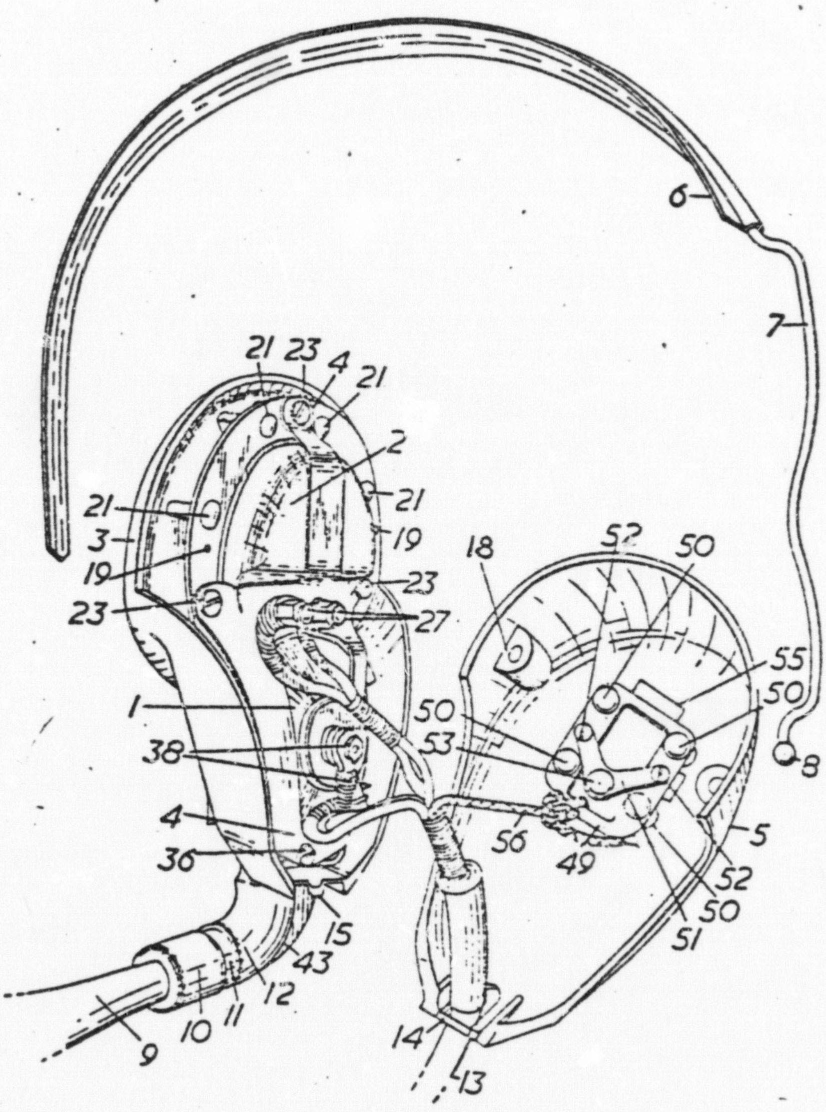


FIG. 2.



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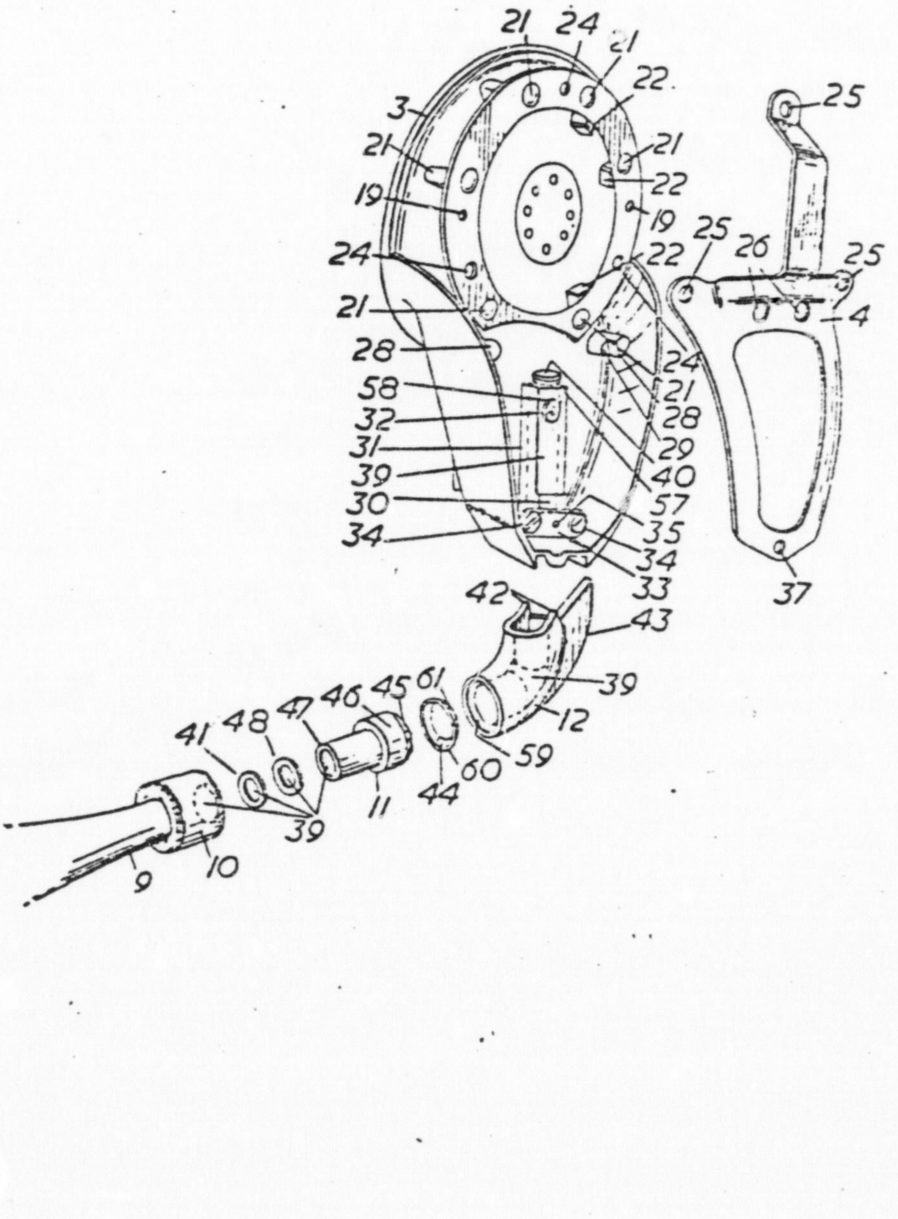
... 56 COMPLETE SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 2 & 3

FIG. 3.



FLEHR, HOHBACH, TEST
ALBRITTON & HERBERT

1969 AUG 20 AM 9:45

RECEIVED

PLAINTIFF'S EXHIBIT 139

LAW OFFICES OF

COOPER, DUNHAM, HENNINGER & CLARK

330 MADISON AVENUE, NEW YORK, N.Y. 10017

TELEPHONE: 212-697-4520
CABLE ADDRESS KERCURTIS

ROBERT S. DUNHAM
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THOMAS F. MORAN
HOWARD J. CHURCHILL
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ROBERT SCOBEY

JOHN F. OHLANDT, JR.
ABRAHAM ENGEL
THOMAS P. DOWD
NORMAN H. ZIVIN
IVAN S. KAVRUKOV

August 19, 1969

Aldo J. Test, Esq.
Flehr, Hohbach, Test, Albritton & Herbert
160 Sansome Street
San Francisco, California 94104

Re: Your file I-25014 - Our O.F. 890

Dear Mr. Test:

Your letter of June 13, directed to the attention of Mr. Richard W. Howell, President of Roanwell Corporation, has been referred to me for reply.

We have had previous correspondence with counsel for Pacific Plantronics, Inc., regarding this patent. Our position has been rather clearly set forth in my letter of August 19, 1965 to John P. Austin, Esq., a copy of which is enclosed

I do not see that the matter requires any further opinion or assurances from either me or my client.

Very truly yours,

Lester W Clark

Lester W. Clark

LWC:CEM
Enc.

P.S. After checking the Model 61A Head Set, I cannot understand how you are reading any claim of Larkin patent No. 3,184,556 on that head set.

LWC Ex. 139 519

PLAINTIFF'S EXHIBIT
140

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK

PLANTRONICS, INC.,	)	
	)	
Plaintiff,	)	
v.	)	CIVIL ACTION
	)	NO. 72CIV1625
ROANWELL CORPORATION,	)	
	)	
Defendant.	)	

PLAINTIFF'S EXHIBIT 140

520
Ex. 140

ROANWELL
CORPORATION

MODEL R-70A LIGHTWEIGHT TELEPHONE OPERATORS' HEADSET

Transducers Meet Telephone Industry Standards of Quality
Behind-the-Ear Design Offers Comfort and Lightness

Model R-70A behind-the-ear telephone operators' headset, designed and manufactured by Roanwell, has wide applications including PBX and other console operations.

The transducers employed in the R-70A are characterized by high resistance to shock, low distortion and lightweight. The adherence of the R-70A transducers to telephone quality standards distinguishes this model from competitive headsets of a similar design.

The R-70A is supplied with five flexible ear inserts of varying sizes. The selection of ear inserts is intended to provide each operator with as comfortable a fit as possible.

Several electronic amplifier options are available, each housed in the R-70A plug assembly. Features include elimination of background noise and gain compensation over a wide range of operating voltage and input signal conditions.

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001462

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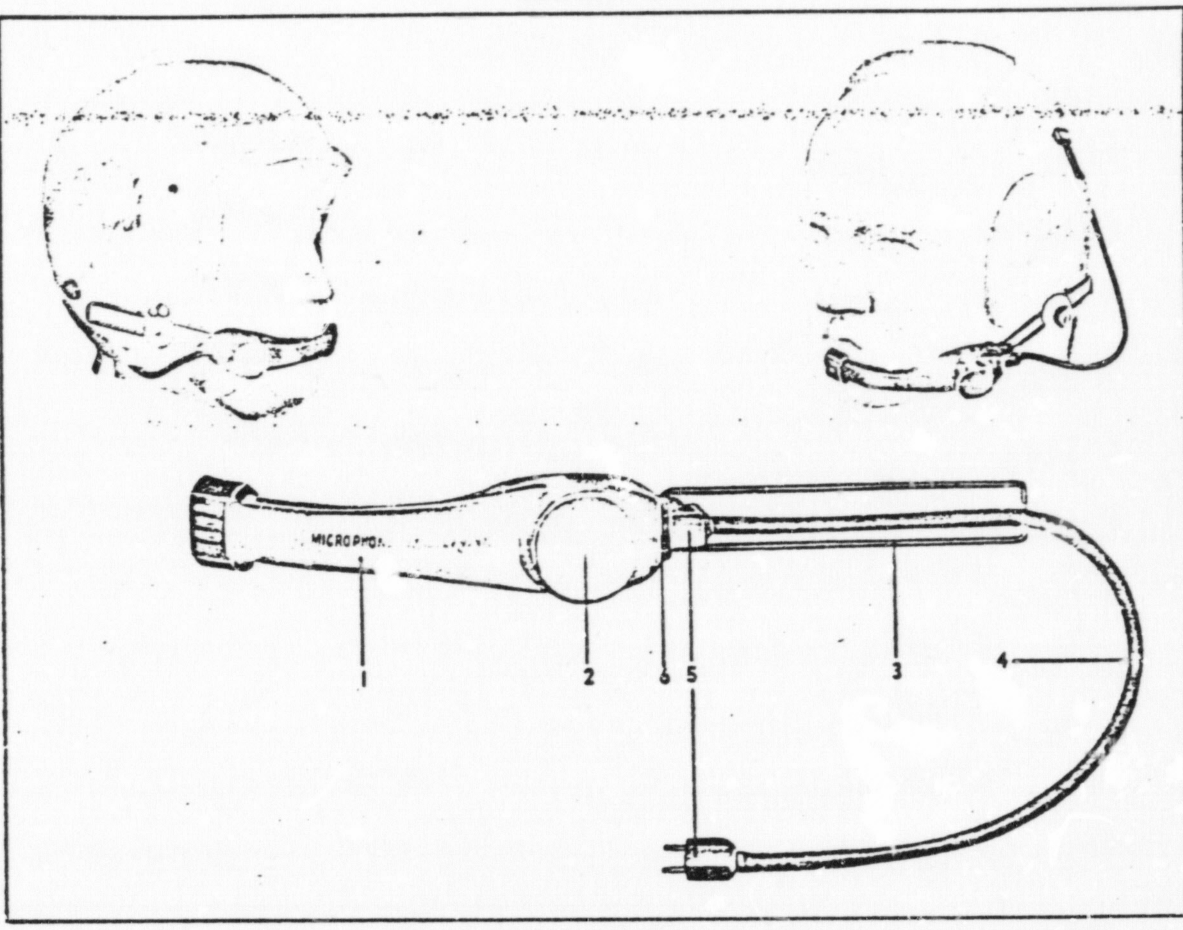
Roanwell

DYNAMIC NOISE-CANCELING MICROPHONE

MODEL RM-33



DESCRIPTION

The Roanwell Model RM-33 Microphone is a close talking, noise-canceling, dynamic (moving coil) microphone. Its military version is Microphone M-33A/AIC (USAF).

As depicted above, the microphone is designed to be used on various headset and helmet assemblies in high ambient noise level areas. The voice tube (1) allows the dynamic microphone element (2) to be placed away from the user's lips without loss of the voice signal. The boom mounting arrangement (3) is ideal for use in those communication systems that necessitate the operator to have free hands.

This microphone differs from its predecessor (Microphone M-33/AIC) in that its cordset (4) is removable. The cordset is equipped with two Roanwell Model RPL-173(32) miniature plugs (5) (military type U-173/U) which are described more fully in Data Sheet DS-32. Either end of the cord may be inserted into the microphone case (6) which has a receptacle similar to the U-179/U Receptacle.

Roanwell

DYNAMIC NOISE-CANCELING MICROPHONE

= -[illegible] db m / 93 db SPL
= - 71.3 db m / 74 db SPL

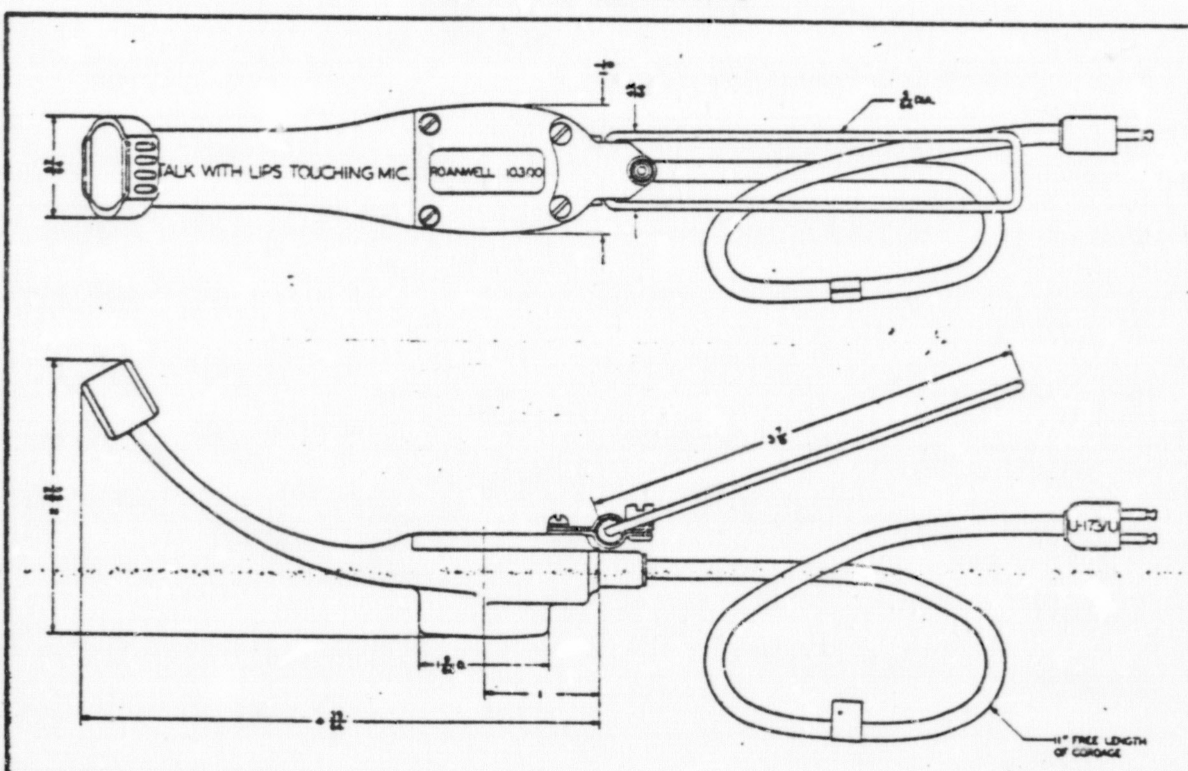
MODEL RM-33

TECHNICAL DATA

= -1.47 µV / 74 db SPL

Sensitivity	−47 db re 1 mv/dyne/cm²
Frequency Range	200 cps to 5000 cps
Noise-Cancellation	Approximately 20 db over entire frequency range
Output Impedance	1.7 ohms
Harmonic Distortion	Less than 1% at normal speech levels
Directivity	Close talking; noise-canceling
Cordage	2 conductor; 13 inches long
Termination	U-173/U miniature plug (one at each end of cord)
Weight	3.0 oz.
Testing Specification	MIL-M-9239 (USAF)
Roanwell Part Number	10300

OUTLINE DRAWING



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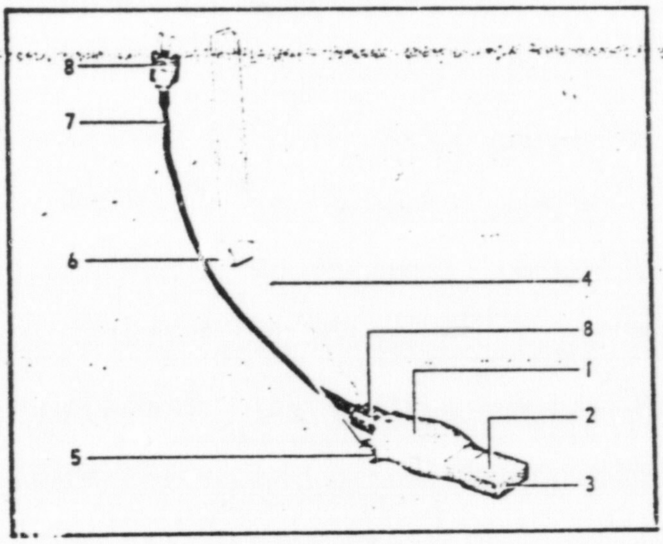
Roanwell

DS-41

DYNAMIC NOISE-CANCELING MICROPHONE ASSEMBLY

MODEL RBM-87(41)



DESCRIPTION

Roanwell Model RBM-87(41) Microphone Assembly is a close talking, dynamic, noise-canceling, boom-mounted microphone. Its military version is Microphone, Dynamic M-87/AIC.

The RBM-87(41) is designed for use on a headband type headset at low altitudes or for use in a full pressure type oxygen helmet at high altitudes. Its relatively wide, distortion free, frequency range and excellent noise canceling qualities provide communication of high intelligibility under adverse high ambient noise conditions. The microphone is a small, light weight unit that measures 2-9/32 inches long, 1 inch wide and 11/16 inch thick. Without the cordset and mounting boom, it weighs only 22 grams. The case (1) is molded from gray high-impact thermoplastic. A thin membrane (2) covers each of the two grids (one each front and back). The membrane serves both as a breathblast shield and as a seal to prevent the entrance of moisture and dust into the microphone. A removable guard (3) of gray colored plastic fits snugly over the mouth-piece to protect the moisture barrier membranes.

The RBM-87(41) is equipped with a stainless steel wire boom (4) for assembly to various headsets. The microphone is attached to the boom by a friction joint (5) which allows proper positioning of the microphone in front of the user's lips. An additional hinge joint (6) permits the microphone to be swung away from the face.

The cordset contains two bunch-stranded, tinned cadmium bronze wire conductors insulated with Teflon and jacketed by a black nylon braid. The cordset (7) is approximately six inches long and is terminated at each end with Roanwell Model RPL-173(32) Miniature Connector. Either connector (8) may be inserted into the microphone receptacle. When connected with the microphone, two contact screws in the microphone receptacle hold the connector contacts firmly in place to assure minimum contact resistance and to preclude accidental disconnect. The RPL-173(32) Miniature Connector is covered in Data Sheet DS-32.

Roanwell

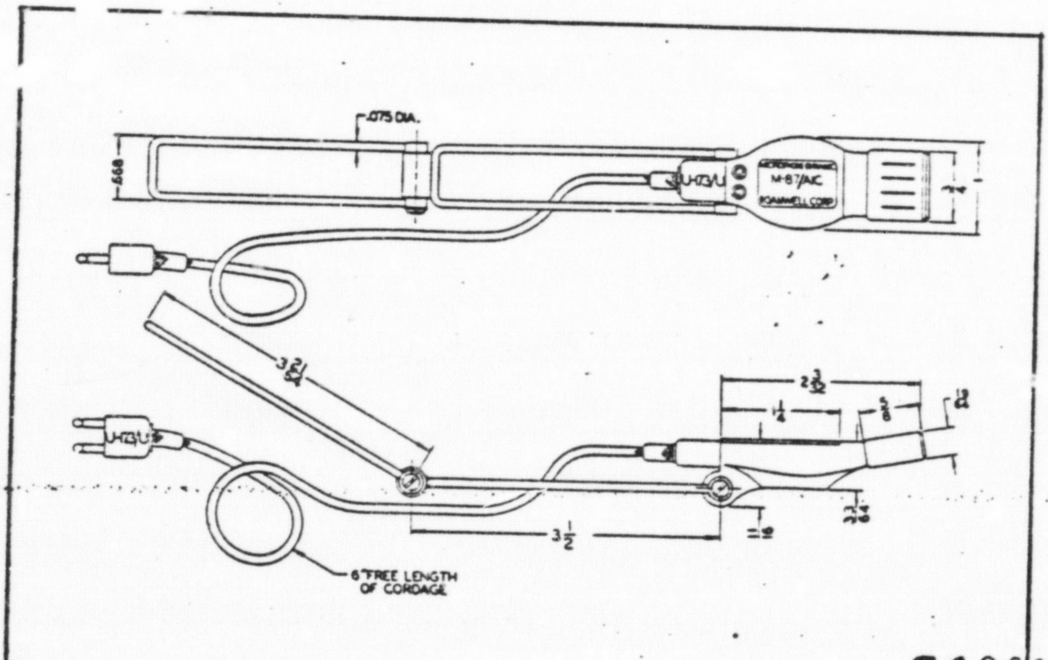
DYNAMIC NOISE-CANCELING MICROPHONE

MODEL RBM-87(41)

TECHNICAL DATA

SENSITIVITY	-72 db re 1mw/newton/m² (10 dynes/cm²)
FREQUENCY RANGE	200 — 5000 CPS
NOISE-CANCELATION	Noise-cancelation feature permits transmission of intelligible speech in a 120 db ambient noise field.
OUTPUT IMPEDANCE	3.5 Ohms
HARMONIC DISTORTION	Less than 1% at normal voice levels (about 93 db)
DIRECTIVITY	Bidirectional
CORDAGE	2 conductors; 6 inches long (approximaetly)
TERMINATION	RPL-173(32) Miniature Plug (one at each end of cord) Military Type U-173/U
WEIGHT	22 grams (less boom and cordset)
TESTING SPECIFICATION	Roanwell No. 3136 or MIL-M-26542(1)
ROANWELL PART NUMBER	10689

OUTLINE DRAWING



EP 3603

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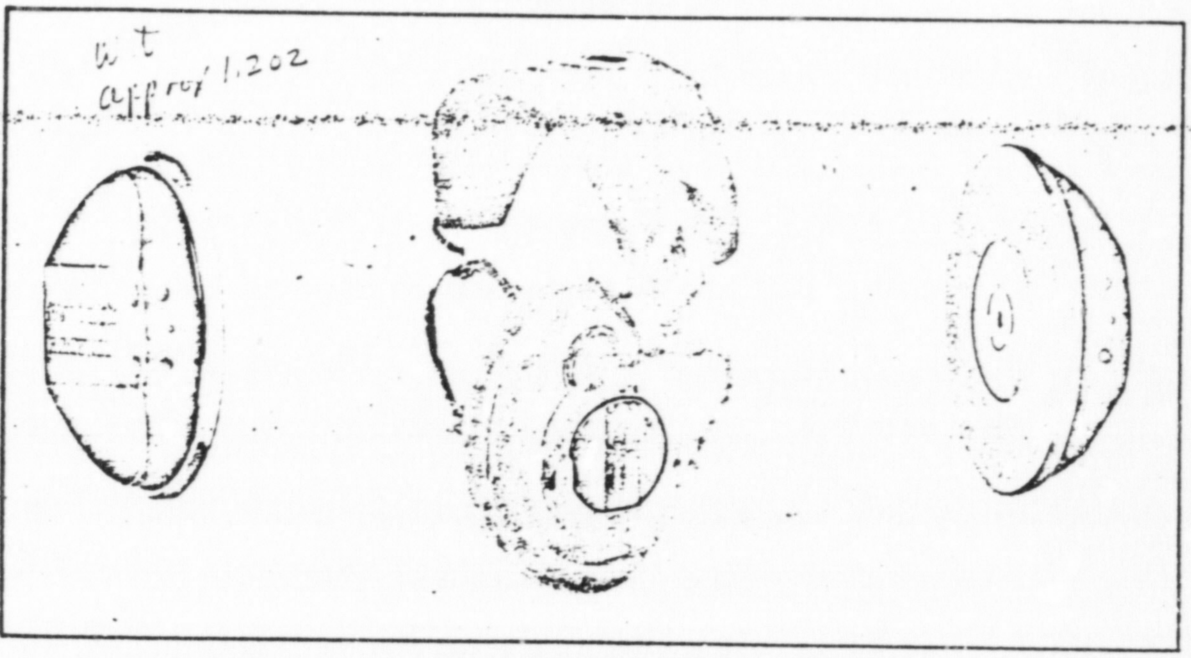
Roanwell DS-33

DYNAMIC EARPHONE ELEMENT

MODEL RH-143R



wt approx 1.2oz

DESCRIPTION

The Roanwell Model RH-143R Earphone Element is a lightweight, dynamic (moving coil) unit designed for use primarily in headset (as shown above) and helmet assemblies. Its military version is Earphone H-143/AIC (USAF), which replaces USAF Telephone Receiver H-79/AIC (See Data Sheet DS-30) in most military applications.

This earphone provides a high output with substantially reduced weight and its rugged construction permits adherence to the stringent requirements of USAF Specification MIL-E-25670, assuring dependable operation and long life under the most severe conditions.

Its altitude compensating design results in uniform output, independent of air pressure, and neither the efficiency nor life of the earphone is adversely affected by prolonged exposure to humidity or temperature extremes. The specially designed diaphragm, with self-supporting voice coil, is protected by a contoured guard against shock and explosive decompression. Locking screws are used in the terminal block for minimum contact resistance.

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Roanwell

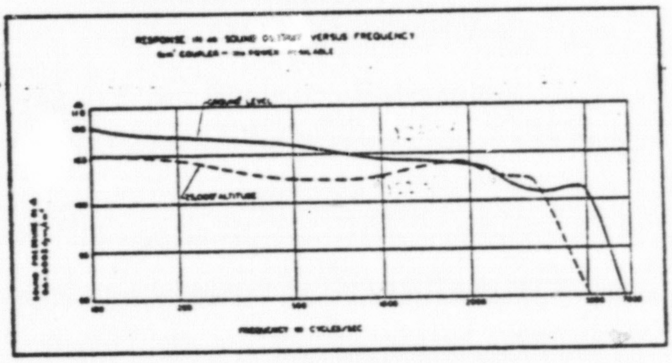
DYNAMIC EARPHONE ELEMENT

MODEL RH-143R

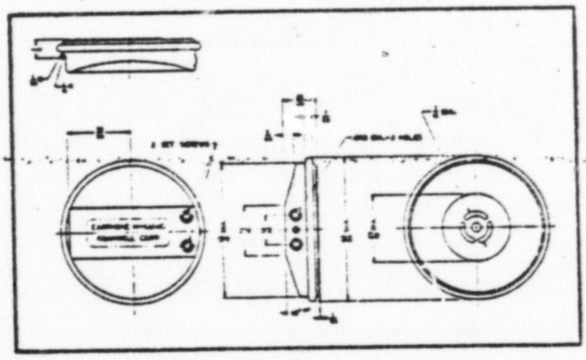
TECHNICAL DATA

Sensitivity	105 db at 1000 cps re 0 db .0002 dynes/cm² with input of 1 mw
Frequency Range	100 cps to 5500 cps
Impedance	20 ohms
Harmonic Distortion	Less than 3% with 100 mw applied
Weight	Less than 35 grams
Testing Specification	MIL-E-25670 (USAF)
Roanwell Part Number	10301

TYPICAL RESPONSE CURVE



OUTLINE DRAWING



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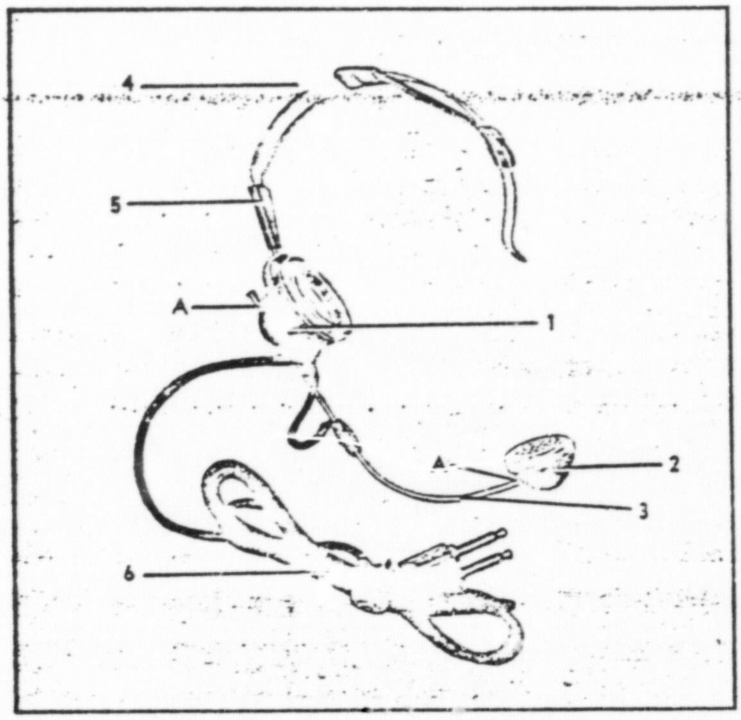
Roanwell

DS-27

TELEPHONE OPERATOR'S HEADSET

MODEL R-52 AW



DESCRIPTION

The R-52AW is Roanwell's high quality Telephone Operator's Headset. This unit is a light weight, compact headset that is comfortable to wear and easily adjusted to individual preference.

The receiver and transmitter housings (1 & 2) are molded of high impact thermoplastic and are connected by the adjustable stainless steel boom (3). The headband (4) is made of high grade spring steel that holds the unit firmly on the operator's head. The triangular adjustment block (5) is made of aluminum, with three individual adjustments to allow up to $1\frac{1}{2}$ inch extension of the headband.

The microphone boom (3) extends thru the back of the receiver housing and has a dual adjustment; one to vary the length of the boom, and another to raise or lower the boom. The microphone can be rotated on the end of the boom to adjust the angle in relation to the operator's lips.

The positioning joints (A) use spring pressure to provide smooth adjustment and constant tension in any position.

Silver plated spring contacts are used in the receiver and transmitter housings to assure low contact resistance and dependable operation. The cordset provided (6) has rubber covered tinsel conductors for long flexure life and is covered with black nylon braid. The free length of the cordset is five feet and is terminated in a type 289 B plug.

The high output RC-3 receiver and the RN-1H transmitter, used in this headset, are described in detail in Roanwell Data Sheets DS-6 and DS-40, respectively.

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Roanwell

TELEPHONE OPERATOR'S HEADSET

MODEL R-52 AW

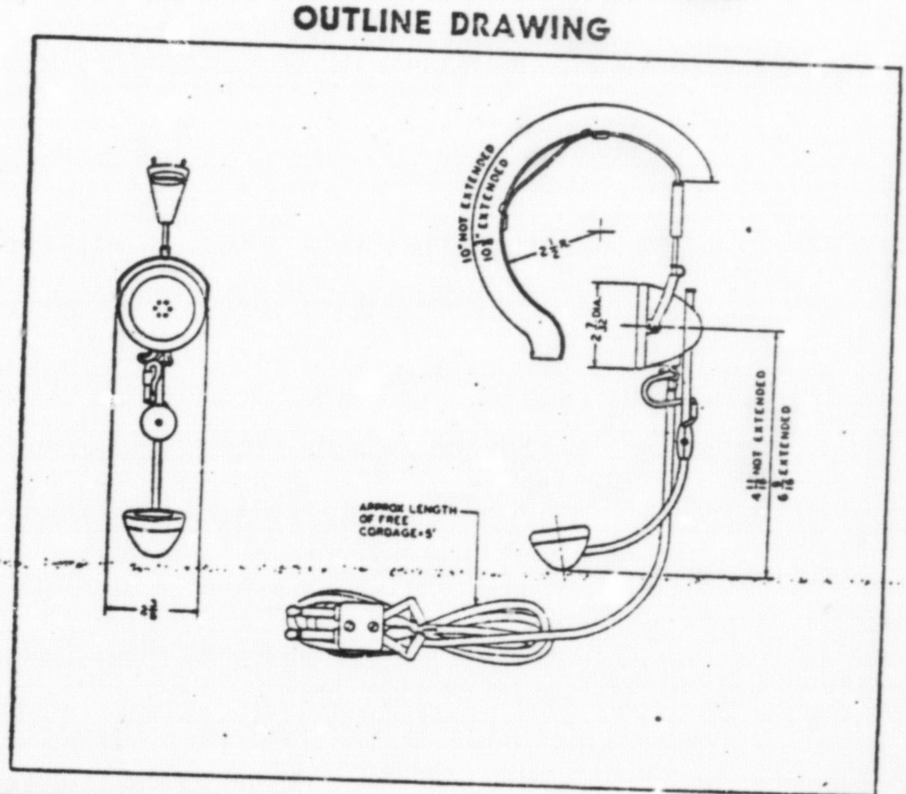
The Roanwell Telephone Operator's Headset Model R-52 AW is equivalent to the Western Electric 52 AW Headset. The basic Headset, with appropriate cordset changes, is also available as follows:

ROANWELL MODEL NO.	WESTERN ELECTRIC NO.
R-52 BW	52 BW
R-52 CW	52 CW
R-52 DW	52 DW
R-52 EW	52 EW

REPLACEMENT PARTS

DESCRIPTION	ROANWELL PART NO.
Headband Assembly	25050
Boom & Transmitter Assembly	25090 S/P
Headband Sub Assembly	25040 S/P
Strap	25070
Receiver Holder	26070
Receiver Cap	14452
Transmitter Cap	14453
Plug	5860
Cordset	6341
Receiver	10027
Transmitter	10258

OUTLINE DRAWING



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Roanwell

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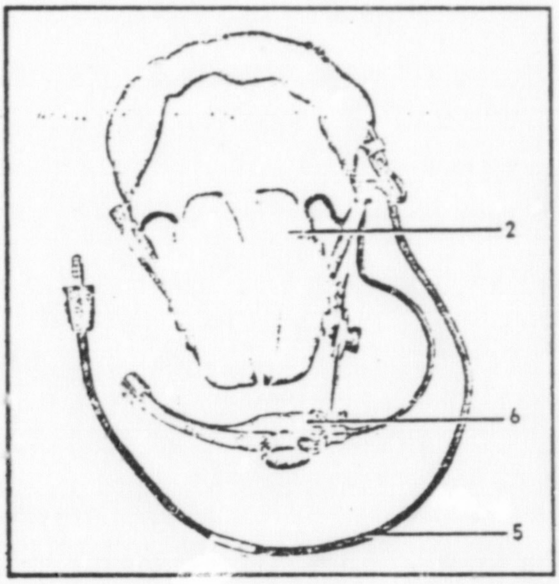
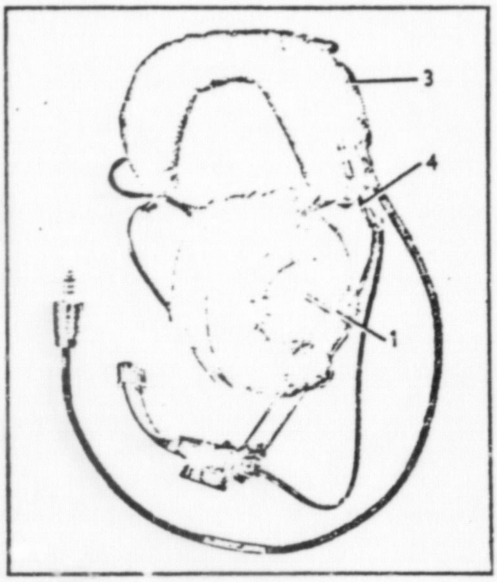
HEADSET-MICROPHONE ASSEMBLY

MODEL RH-78





DESCRIPTION

The Roanwell RH-78 is a dynamic Headset-Microphone Assembly, currently used by the U. S. Air Force. A few of the important features incorporated in the design of the headset are: dependable operation, low distortion, positive earphone positioning, and comfort. The use of quality parts and precision construction has resulted in a rugged and reliable headset adaptable to many applications.

The light weight receivers, (1) *RH-143R are mounted within a pair of noise-excluding ear cushions (2). The ear cushions are formed of foam rubber on a special high impact backing plate, and are covered with non-toxic Hypalon plastic. The detailed contour of the cushions assure maximum noise exclusion. Two spring steel straps, covered with a padded nylon mesh, form the headband (3). The size adjustment and double pivot arrangement assure a close and comfortable fit on the individual's ear. The size adjustment (4) consists of a teflon coated steel strip fitted between two spring loaded nylon bushings. This arrangement provides smooth adjustment and constant tension at any position.

Nominal impedance of the headset, with the receivers connected in parallel, is 9.5 ohms. The microphone is designed to operate into a 5 ohm. load.

The cordset (5) contains six cadmium bronze stranded conductors insulated with latex low temperature rubber and jacketed with a nylon braid. The cabling is specially designed to minimize electrostatic and electromagnetic pickup. The cordset is terminated with a type U-9. A/U plug. The Model RH-78 Headset-Microphone Assembly consists of the Model RH-70 Headset and the Model *RM-33 Microphone. The mounting, furnished with the RH-70 Headset and the Model *RM-33 Microphone. The mounting, furnished with the RH-70 Headset, accommodates the RM-33 Microphone (6) and can be mounted on either side of the headset.

*Complete details of the Receiver RH-143R and dynamic Microphone RM-33 can be found in Roanwell Data Sheets DS-33 and DS-31.

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HEADSET-MICROPHONE ASSEMBLY

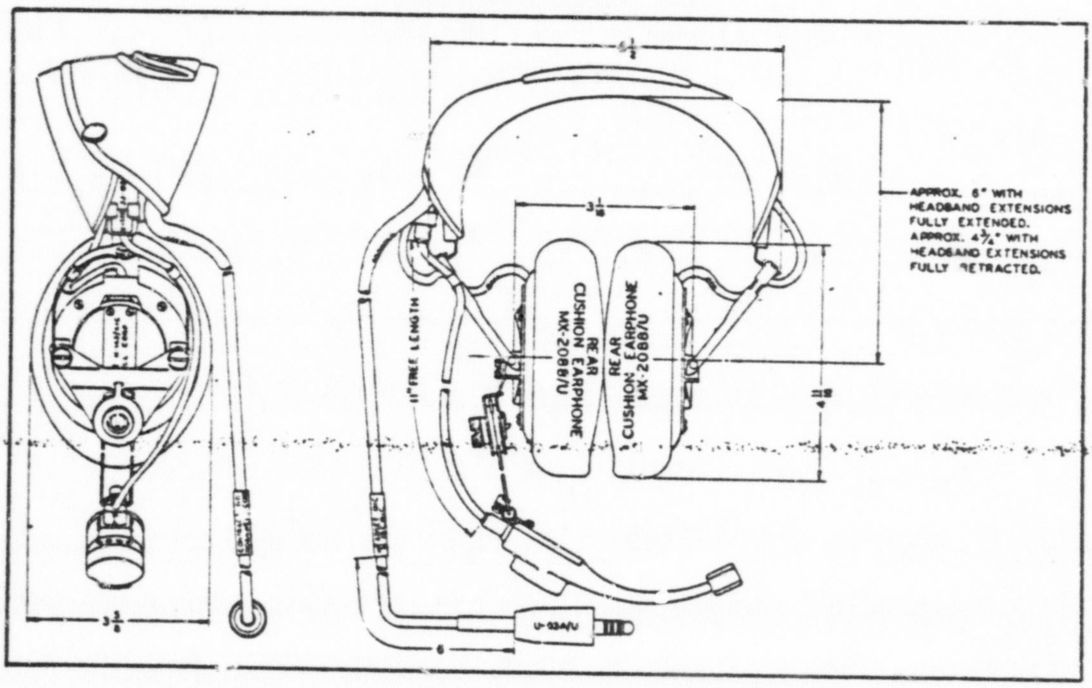
MODEL RH-78

The Roanwell Model RH-78 is equivalent to the Air Force H-78C/AIC Headset-Microphone Assembly.

REPLACEMENT PARTS

DESCRIPTION	ROANWELL PART NO.
Receiver element, dynamic H-143/AIC	10301
Earcushion, hypalon, pair—left and right	10305
Gasket, earphone	14224
Cover, headband — nylon mesh with sponge rubber padding	24580
Cordset assembly—complete with plug, jack and terminals	24560
Microphone, dynamic—noise-canceling—includes adjustable boom and cord—M-33A/AIC	10300
Shield, Microphone—replaceable moisture barrier	24700
Mouthpiece, Microphone—protects microphone shield	14368

OUTLINE DRAWING



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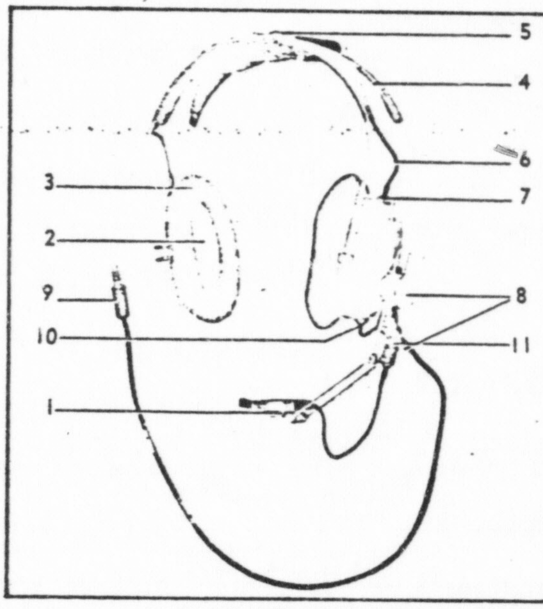
quality headsets lighter than ever for less fatigue than ever, you can specify 500 custom designs.

Roanwell

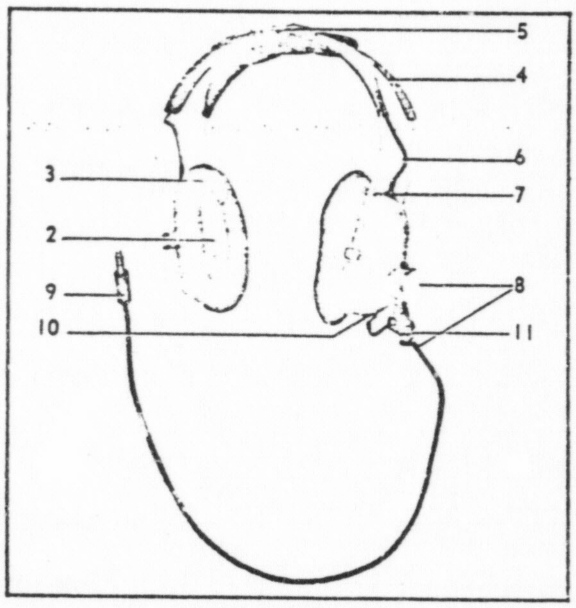
DS-45

HEADSET-MICROPHONE ASSEMBLY

MODEL RHM-157(45)



MODEL RHM-157(45)



MODEL RHM-158(45)

DESCRIPTION

Roanwell Model RHM-157(45) Headset-Microphone Assembly provides (hand-free) high intelligibility voice communication in the adverse noise environment of multi-engine aircraft as well as in other high ambient noise level areas. Its military version is Headset-Microphone H-157/AIC. It consists of Roanwell Model RHE-158(45) Headset and Model RM-87(41) Microphone.*

Roanwell Model RHE-158(45) Headset Assembly provides information reception of high intelligibility and improved wearing comfort that combine to reduce fatigue to a minimum. Its military version is Electrical Headset, H-158/AIC. It is equipped with two Roanwel Model RH-143R Dynamic Earphone Elements. This earphone is a lightweight unit that provides high output and dependable service under the most severe conditions (see Data Sheet DS-33). The earphone elements are mounted in reverse inside the molded, gray, cycolac noise attenuating earcups to minimize cavity resonance. An inside pad of molded foam (2) covers the earphone to further reduce resonant modes and standing waves of the infringing noise and of the signal. Each earcup is covered with a removable circumaural earpad (3) made of a resident foam material in a gray heat-sealed vinyl cover. The earpad, which presses firmly but comfortably against the head, serves as an acoustical seal for maximum noise exclusion.

The Headband Assembly (4) consists of two individual bands of formed wire inserted into a headband cover of gray vinyl. Four separate adjustments of approximately 2½ inches each are available for individual preference. For increased comfort, a Headband Pad (5) of foam-filled, gray, heat-sealed vinyl snaps around the headband cover.

The headband Jumper-Cord Assembly (6) contains two tinned cadmium bronze conductors insulated with Teflon and jacketed with braided black nylon. It is terminated at each end with a Roanwell Model RPL-173(32) Miniature Connector (7). See Data Sheet DS-32.

The Cordset and Bracket Assembly (8) contains six tinned cadmium bronze stranded conductors insulated with Teflon. It is jacketed in black nylon braid and includes a stay-cord made of extra-strength braided rayon to protect the connectors from any stress that might cause accidental disconnect. The bracket mechanism assembles the main cordset and the microphone assembly to the headset. At the end that connects with the communication system, the cordset is terminated with a U-174/U Miniature Plug (9). At the branched end, it is terminated with an RPL-173(32) Miniature Connector (10) that fits into the headset receptacle and with an RPL-172(32) Miniature Jack (11) that accepts the microphone connector. The cordset and bracket assembly can be attached to either earcup for mounting the microphone assembly.

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DS 45-1M561 * This microphone described in DS-41

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NEW YORK, N.Y. 10014
Phone: (212) 989-1090

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SALES REPRESENTATIVES

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Roanwell

HEADSET-MICROPHONE ASSEMBLY

MODEL RHM-157(45)

The military version of Roanwell Model RHM-157(45) is Headset-Microphone, H-157/AIC (USAF), Specification MIL-H-26312.

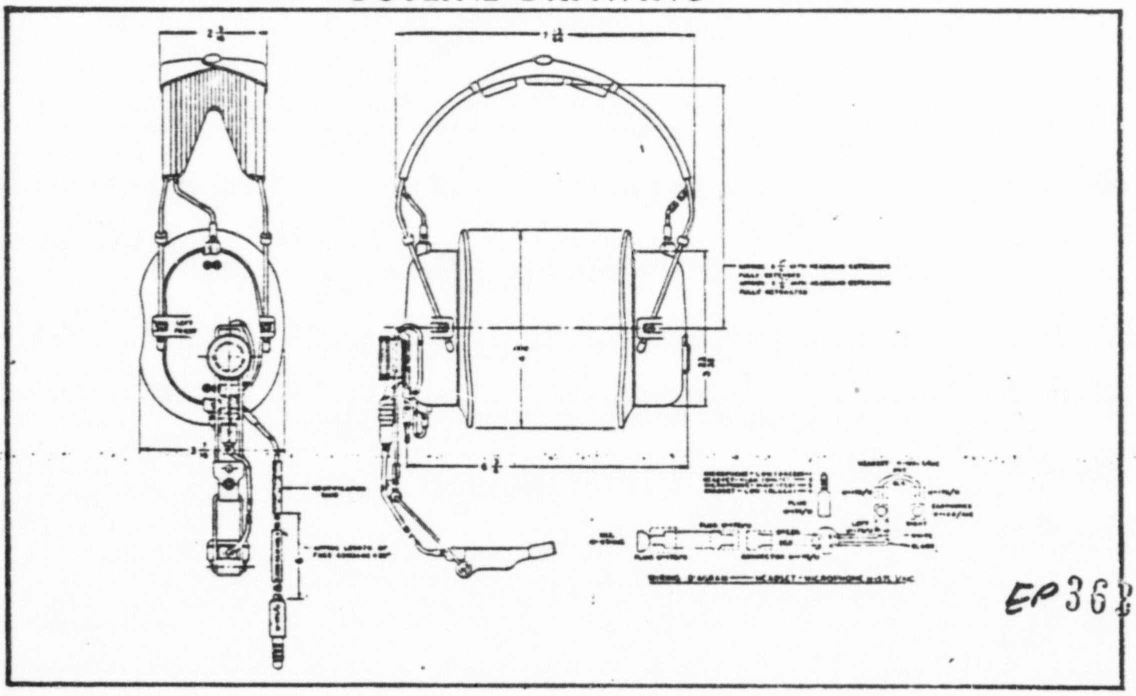
COMPONENT ASSEMBLIES

DESCRIPTION	ROANWELL PART NO.
Model RHE-158(45) Headset Assembly (Type H-158/AIC)	10558
Model RM-87(41) Microphone Assembly (Type M-87/AIC)	10689

REPLACEMENT PARTS

DESCRIPTION	ROANWELL PART NO.
Earphone Element, Dynamic, Model RH-143R (Type H-143/AIC)	10301
Bracket, Cord and Plug Assembly	31470
Headband Assembly (Type MX-2506/AIC)	31450
Cordset Assembly, Headband (Type MX-4434/U)	31500
Cushion, Ear (Type MX-2509/AIC)	15244
Pad, Ear	15245
Pad, Headband (Type MX-2507/AIC)	31410
Earcup Assembly-Left (Type MX-3473/AIC)	31480
Earcup Assembly-Right (Type MX-2508/AIC)	31490
Screw, Plug Contact (Binding hd. #256 X 1/4 brass nickel plate)	6514

OUTLINE DRAWING



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nals into a negative resistance of approximately the same value. The insertion of this negative resistance into the

tin-plated bronze. The use of this new and smaller connector is recommended where the OD of the splice bundle is a

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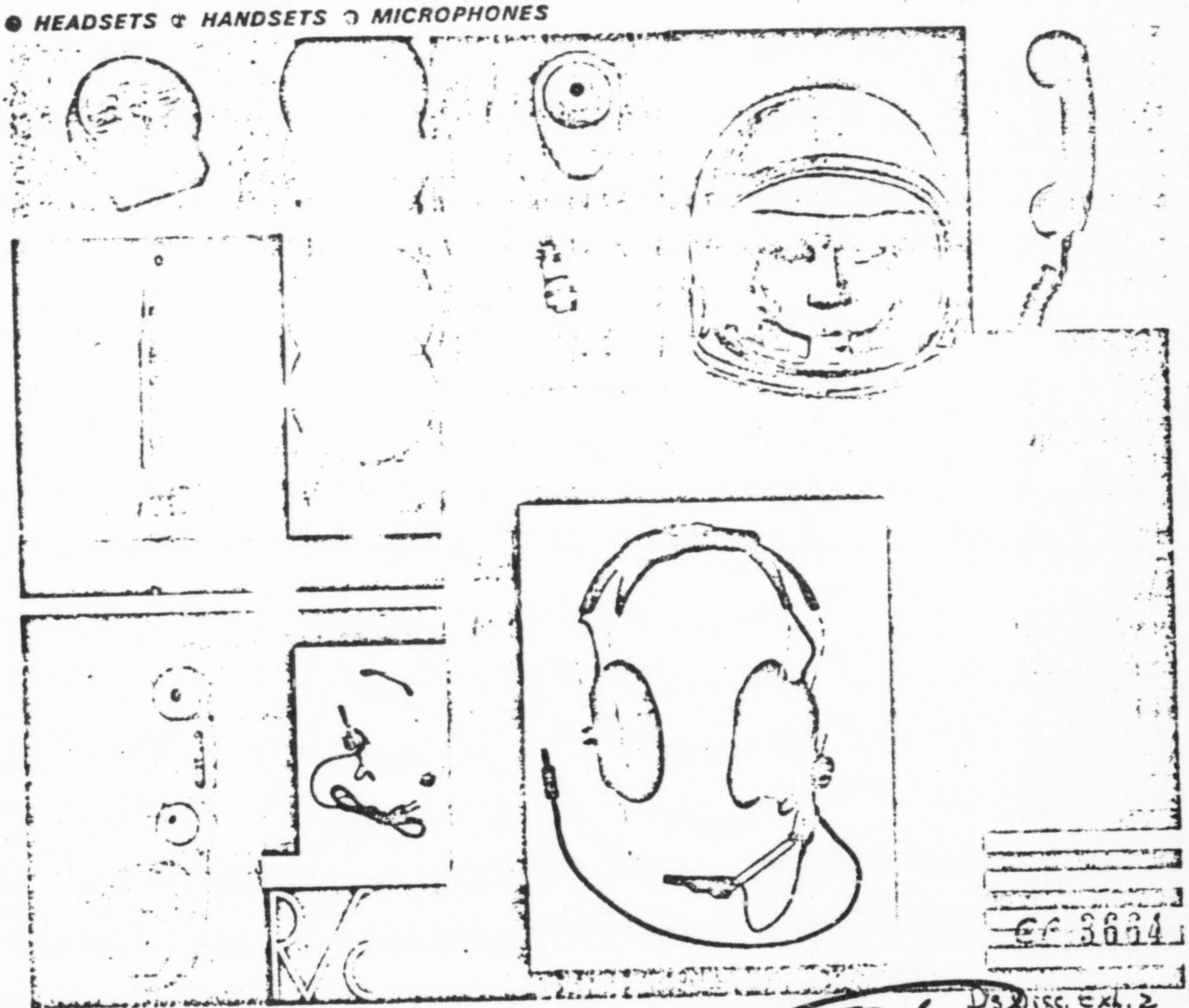
ROANWELL

COMMUNICATIONS TERMINAL EQUIPMENT

● HEADSETS ● HANDSETS ● MICROPHONES



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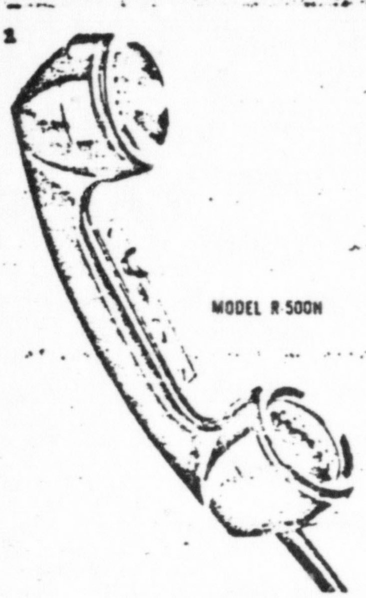
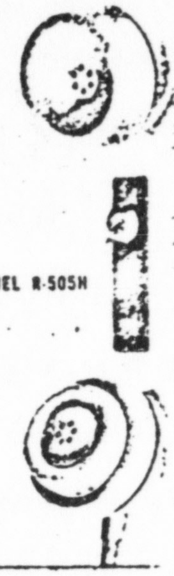


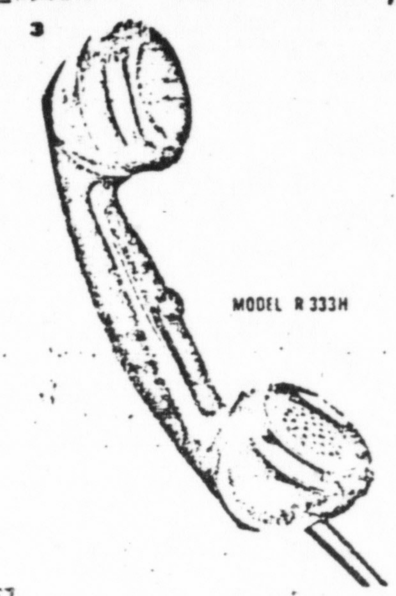
MODEL R-500H

2



MODEL R-505H

3

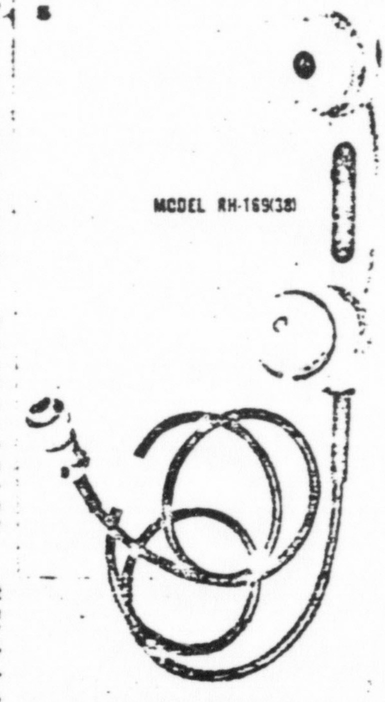


MODEL R 333H

4

BATTLE HANDSET

5



MODEL RH-169(38)

/ **HANDSET MODEL R-500H** New modern shape . . . plus improved "impact" thermosetting phenolic body and heavy silver-plated contacts. Available with magnetic or dynamic earphone elements in various impedences. Microphone elements available are: carbon, carbon noise-canceling, magnetic, dynamic low impedance, dynamic high impedance, dynamic noise-canceling, dynamic transistorized, dynamic noise-canceling transistorized. Switches, cords and plugs to meet your requirements.

/ **HANDSET MODEL R-505H (ALL PURPOSE)** Featuring modern styling, these Roanwell handsets are made of tough, high-impact thermoplastic material. Model R-505H Handsets can be supplied in various colors. Lighter in weight than the standard 500 type handsets. Used in mobile, stationary, ship-to-shore, and aircraft radio/telephone systems as well as for general telephone use. The same combinations of replaceable cartridge microphone and earphone elements can be supplied as for the Model R 500H Handsets. Your choice of switch, cord and plug assemblies.

/ **HANDSET MODEL R-333H "F" type handset** designed for use with mobile, aircraft or marine radio/telephone. Made of polished "impact" thermosetting phenolic. Available with dynamic or magnetic earphone elements of various impedances. Microphone elements available in dynamic, carbon, carbon noise-canceling, magnetic. Many combinations of switches, cords and plugs.

/ **BATTLE HANDSET** Lightweight, all dynamic handset. Designed to meet all environmental requirements of rugged field use. Complete handset immersion-proof. Equipped with dynamic earphone with matching transformer and dynamic noise-canceling microphone with transistorized amplifier to meet circuit requirements. Microphone affers [illegible] db minimum noise cancellation (JRB method). All case material high-impact plastic. Microphone and earphone sub-assemblies constructed as replaceable units for quick field repair. Cordage and connector as required.

/ **HEAVY-DUTY HANDSET MODEL RH-169(38)** A Roanwell developed handset for communications on naval vessels. Designed to meet the most rugged operating conditions. Handle is made of gray, high-impact, thermosetting plastic. Equipped with a 600 ohms dynamic earphone element with a frequency response of 200-5000 cps and a dynamic, noise-canceling microphone element with a transistorized amplifier. Recommended load impedance 50 ohms. Microphone frequency response [illegible] cps. Button-operated, push-to-talk soft action switch can be wired to operate relay. Military version: Handset Assembly H-153/U (U.S. Navy). Can be supplied with Electric Cable Assembly CX-1846A/U as shown.

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D's Disc. Exh. 2

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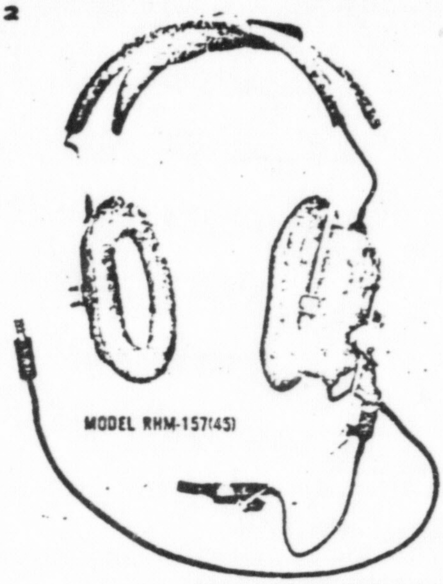
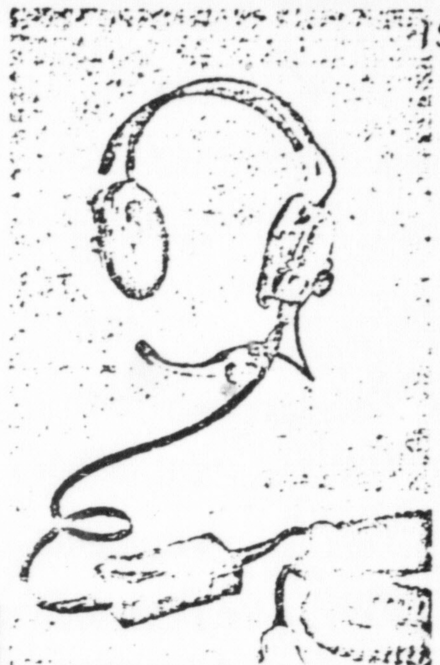
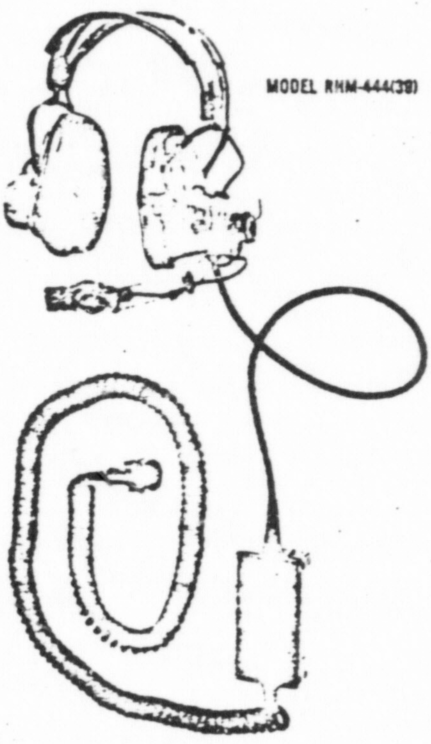
ROANWELL STEREO HI-FI HEADSET



MODEL RHM-157(45)



MODEL RHM-157XPL



MODEL RHM-444(39)

ROANWELL HEADSETS AND HEADSET— MICROPHONE ASSEMBLIES

1 / ROANWELL STEREO HI-FI HEADSET The Roanwell Stereo Hi-Fi Headset is designed to provide the ultimate in listening pleasure. Uses the same high-quality, dynamic (moving coil) earphones as used in astronaut space helmets. Frequency response. 10-18,000 cps. Noise-attenuating earcups eliminate room acoustics, stereo-speakers placement, and listener position. Twenty foot long, four conductor cordset permits monaural, binaural or stereo hook-up. Impedance 20 ohms ± 2 ohms when wired for stereo.

2 / HEADSET-MICROPHONE ASSEMBLY MODEL RHM-157(45) New type headset-microphone incorporating latest advancements. Uses 2 Dynamic Earphones Model RH-143R connected in parallel for headset impedance of approx. 10 ohms. Gray hardshell earcups molded of high-impact Cycolac attenuate approx. 30db of ambient noise at 1,000 cps. Microphone RM-87(41) is dynamic, noise-canceling (3.5 ohms) mounted on adjustable boom. Cordset is black nylon braided 25 in. free length, terminated in Connector U-174 / U. Military version: Headset-Microphone H-157 / AIC (Supersedes and is electrically interchangeable with Headset Microphone Model H-78C / AIC.)

3 / EXPLOSION-PROOF HEADSET-MICROPHONE MODEL RHM-157XPL This headset is safe for use in an explosive atmosphere (as tested per MIL-E-4970). It typifies Roanwell's ability to supply special purpose headsets for difficult applications. Includes a switch, miniature audio amplifier and explosion-proof potentiometer all housed in the switch case. Uses dynamic microphone and earphones. Similar headsets can be supplied to your specifications.

4 / HEADSET-MICROPHONE ASSEMBLY RHM 444(39) Offers high intelligibility under high ambient noise conditions. Model RHM-444(39) Headset Microphone was designed to be worn under the M-1 Steel Combat Helmet. Uses Roanwell RH-143H Ultra High-Output Dynamic Earphones housed in olive-drab noise attenuating earcups. Earphone frequency response 100-4,500 cps with sensitivity of 110db minimum (at 1,000 cps ref. 0db = 0.0002 dyne / cm² with input of 1 mw). Headset impedance 10 ohms nominal. Microphone is dynamic, noise canceling (3.4 ohms) with frequency response of 200-6,000 cps. Four conductor cordset 28 in. straight from headset to transisturized amplifier switch assembly, 4 conductor 15 ft. (extended) retrax cord from switch to U-77 / U Connector.

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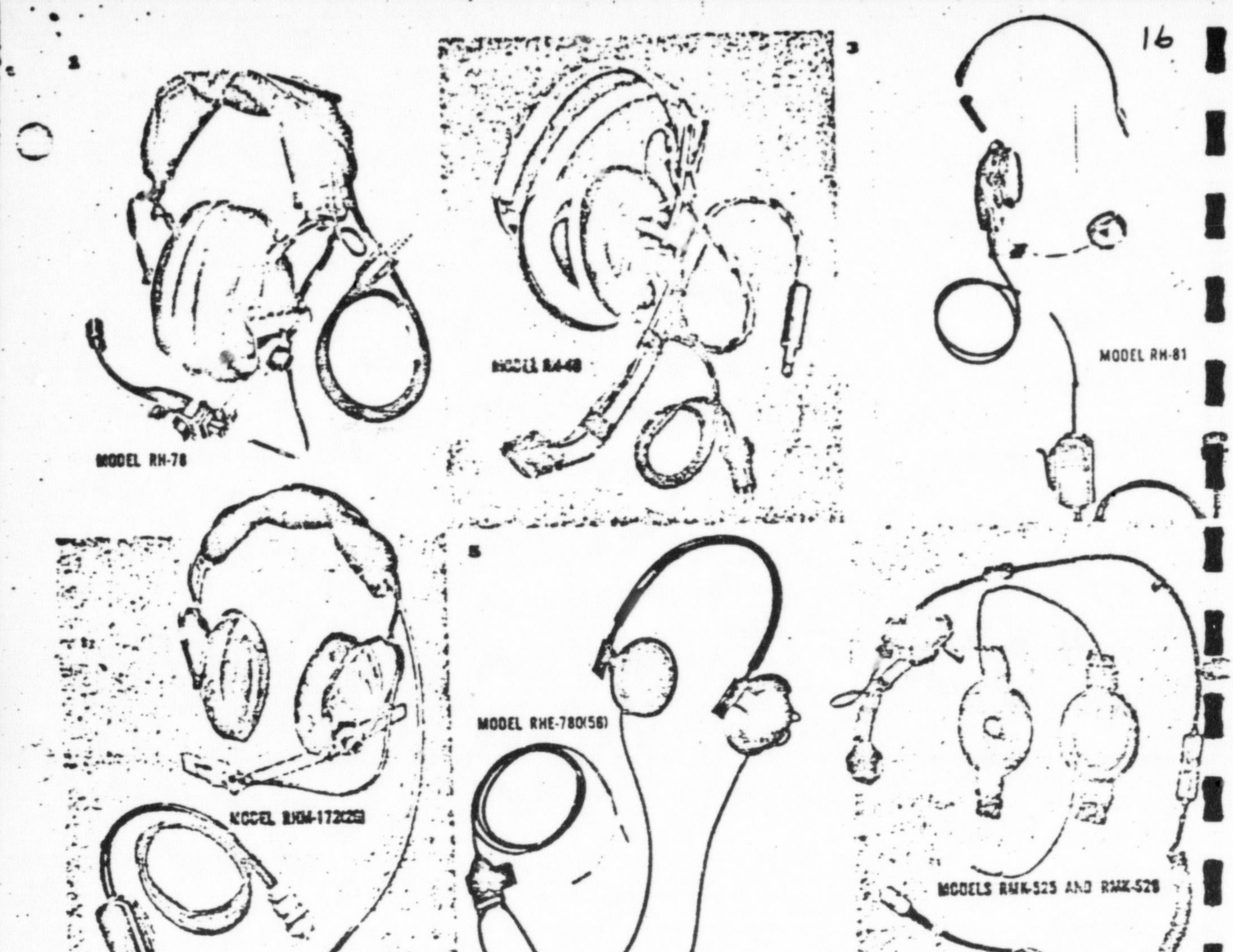
D's Disc. Exh. 2

16



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17

1 / HEADSET-MICROPHONE ASSEMBLY MODEL RH-78 A rugged, highly efficient headset. Equipped with two Model RH-143R Earphone Elements. Multiple pivot points, padded headband and circumaural Hypalon earcushions assure an accurate and comfortable fit. The Model RM-33 Noise Canceling Dynamic Microphone (2 ohms) can be mounted on either side of the headset and adjusted to any convenient position. Total headset impedance approximately 10 ohms. Cordset is ...ck nylon braided, approx. 22 in. free length, terminated in Plug U-93A/U. ...ilitary version: Headset Microphone H 78C/AIC.

2 / HEADSET-MICROPHONE ASSEMBLY MODEL RH-46 Roanwell Model R...6 Headset Microphone Assembly consists of two Model ANB-H-1 Magnetic Earphone Elements surrounded by kapok filled doughnut type ear cushions. Total headset impedance: 600 ohms. Noise-canceling Carbon Microphone, Roanwell Model RM-6, has impedance of 40-100 ohms. Headset cord is approx. 17 in. free length cotton braided, terminated in Plug PJ-054. Microphone cord is neoprene jacketed approx. 21 in. free length, terminated in Plug PJ-292. Military version of Headset Microphone: H-46A / UR. Military version of headset alone: Headset HS-33A. Military version of microphone, boom, bracket assembly: M-3A / A Assembly. Military version microphone only: Microphone M-6A / UR.

3 / HEADSET-HANDSET MODEL RH-81 May be used as headset or, with headband removed, as folding handset. Microphone and earphone encased in rubber. Uses RN-1 Carbon Microphone Element (30 ohms) and RC-3 Magnetic Earphone Element (275 ohms). 4 conductor rubber covered cordset with Switch No. 9902 (see page 14 Item 1), terminated in Plug U-77/U. Cordage length: from headset to switch 30 inches; from switch to plug 38½ inches. Military Version: Handset-Headset H-81A/U.

4 / HEADSET-MICROPHONE ASSEMBLY MODEL RHM-172(26) Used with inter-ship and ship-to-shore radio control sets. Equipped with one RH-79 type Dynamic Earphone Element (600 ohms) and an RBM 87(41) type Dynamic, Noise-Canceling Microphone with transistorized amplifier to match circuit. Open left cushion permits wearer to hear conversation in immediate area. Nylon mesh covers over earcushions alleviate discomfort from perspiration. Push-to-talk switch has clamp to attach switch to clothing. 5 conductors cordset, impervious polyvinylchloride jacket, 24 in. from headset to switch, 51 in. from switch to plug, terminated in MS-3106A-14S-5P Plug and MS-3057-6 Cable Clamp. Military version: Headset-Microphone H-172 / U. (Electrically interchangeable with Heavy Duty Handset H-169 / U)

5 / MINE DETECTOR HEADSET MODEL RHE-780(56) Designed for use with latest transistorized mine detectors, this headset is completely waterproof and can be worn under a standard infantryman's helmet. Uses 2 magnetic earphone elements, frequency response 100-4,000 cps. Headset impedance is 1,000 ohms (when measured at 2,500 cps). Two conductor "Y" cord, neoprene jacketed, terminated in eye lugs. Length of cord from "Y" to eye lugs is 48 inches.

6 / HEADSET-MICROPHONE KIT MODELS RMK-525 AND RMK-526 These kits are designed to operate reliably in the harsh noise-spectrum of tracked combat vehicles. The kits are mounted in crewmen's helmets. Equipped with dynamic earphone elements and a dynamic noise-canceling microphone. Both microphone and earphones are blast-proof and waterproof, impedance: headset 600 ohms; microphone 150 ohms. 5 conductor shielded retrax cordset with switching arrangement and quick-disconnect connection, terminated in U-182 / U Connector. Military version: Headset-Microphone Kit MK-525( ) / G used with Helmet T-56-6; Headset-Microphone Kit MK-526( ) / G used with Helmet CVC-T56-6.

7 / CLAMP-ON HEADSET-MICROPHONE ASSEMBLY Has special clamps for attaching headset to the rim of a baseball type hardhat where an under-the-helmet headset cannot be used. Clamp-on headsets can be supplied with one earcup and a variety of microphone and earphone elements. Switch, cord, and plug assemblies as required.

8 / HEADSET-HANDSET MODEL RH-108 Features light weight (only 6 oz. without headband and cordage), smart appearance, high efficiency and comfort. Non-twist square boom to resist abuse. Carbon microphone (30 ohms) and magnetic earphone elements (275 ohms) interchangeable with those in other high quality telephone operator headsets. Cordset is 30 in. neoprene jacketed, 3 tinsel conductor terminated in 3 way polarized jack. Other plugs and cords as needed. Military version: Handset-Headset H-108A / U.

9 / HEADSET-HANDSET MODEL RH-108B One Hypalon earcushion contains a Magnetic Earphone Element (Roanwell Model RC-3, impedance 275 ohms). The other is open to allow the operator to receive instructions from outside the networks. Carbon Microphone Element is Roanwell Model RN-1 (impedance 30 ohms). Cordset is 30 in. neoprene jacketed, 3 conductor tinsel cord with 3 way polarized jack. Other plugs and cords on request. Military version: Headset-Microphone H-108B/U.

10 / HEADSET-MICROPHONE ASSEMBLY MODEL RHE-163(43) Ideal for use in broadcasting stations and at missile launching site control centers. Model RHE-163(43) incorporates two Model RC-3 Magnetic Earphone Elements (headset impedance 550 ohms) mounted in circumaural Hypalon earcushions and a Model RN-1 Carbon Microphone Element (30 ohms). 30 in. cordset contains 3 tinsel conductors terminated in 3 way polarized jack. Other cordage and terminations available. Military version: Headset-Microphone H-163( ) / U.

11 / HEADSET-MICROPHONE ASSEMBLY MODEL RH-108AM(44) Operator type headset that permits hands free operation and leaves one ear of user unobstructed for communicating in immediate work area. Headband with soft Hypalon-coated foam pad and hardshell Cycolac earcup designed to provide better balance of headset for increased comfort. Electrically interchangeable with Headset-Handset RH-108. Carbon Microphone Element (30 ohms), Magnetic Earphone (275 ohms).

12 / HEADSET-MICROPHONE ASSEMBLY MODEL RH-108BM(44) Electrically interchangeable with Headset-Handset RH-108B. Incorporates gray Cycolac earcups with resilient foam earcushions sealed in gray vinyl plastic. Uses one RC-3 Earphone Element (275 ohms) mounted in left earcup. Right earcup is perforated to permit wearer to hear voice communication in immediate operating area. Uses RN-1 Carbon Microphone Element (30 ohms). Supplied with cordage and plugs to meet requirements.

13 / HEADSET-MICROPHONE ASSEMBLY MODEL RHE-163M(43) A telephone operator's type headset. Electrically interchangeable with Headset-Microphone Assembly Model RHE-163(43). Equipped with two RC-3 Magnetic Earphone Elements and an RN-1 Carbon Microphone Element. Hardshell Cycolac earcups and soft foam-filled earcushions provide maximum comfort and assure that headset will remain firmly in place even when wearer is moving about. Cordage and connectors can be supplied as needed.

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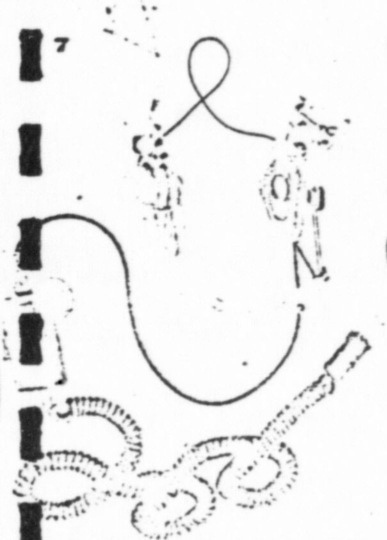

CLAMP-ON HEADSET-MICROPHONE ASSEMBLY

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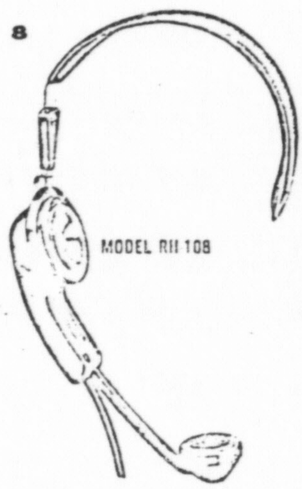

MODEL RH 108

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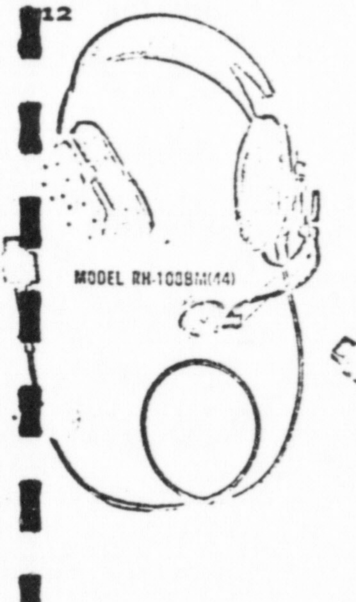

MODEL RH-108BM(44)

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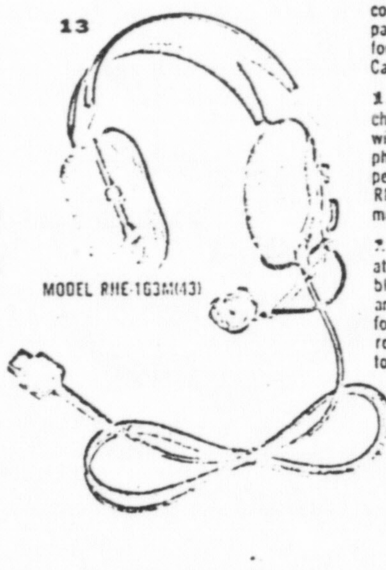

MODEL RHE-163M(43)

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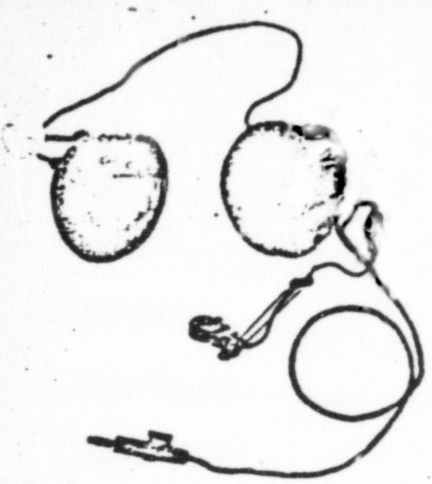
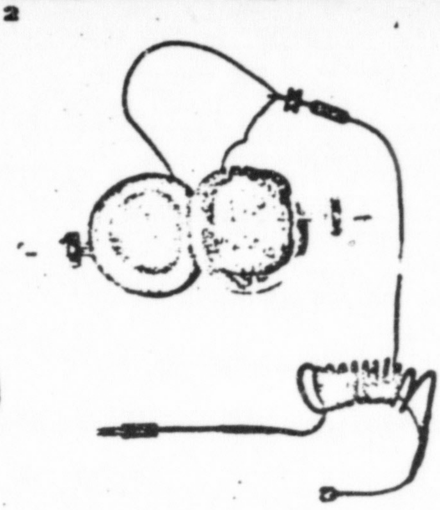


MODEL RHM-221(53)



MODEL RHE-154(47)

MODEL RHE-149(14)

ROANWELL PROTECTIVE HELMET HEADSETS

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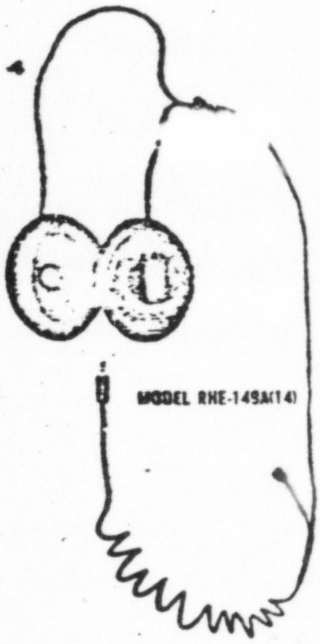

MODEL RHE-149A(14)

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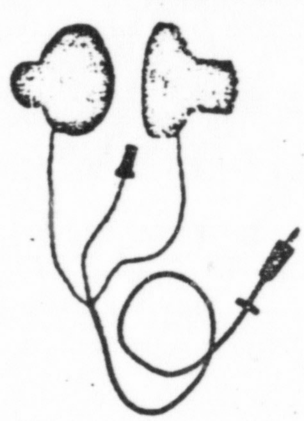
MODEL RHE-75C(42)



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1 / **HEADSET MICROPHONE ASSEMBLY MODEL RHM-221(53)** This pilot's protective helmet headset offers an [illegible] feature. It comes equipped with a boom-mounted RME [illegible] Dynamic Noise-Canceling Microphone for use at low altitudes and also has a special Plug-Switch Connector Assembly that permits a pilot to switch to an oxygen mask microphone when he dons his mask without having to disconnect and reconnect microphones. Equipped with RH-143R Earphones in gray Cycolac noise-attenuating earcups and circumaural earcushions. Headset impedance [illegible] ohms nominal. RME-101(49) Microphone impedance [illegible] ohms nominal. Six conductor cordset with special plug switch connector that mates with the same outlet as a U-174 Miniature Plug. Military version: Headset-Microphone H-221 / AIC.

2 / **HEADSET ASSEMBLY MODEL RHE 154(47)** Used in pilot's protective helmets to provide information reception [illegible] intelligibility under the extreme noise conditions of military aircraft. Equipped with Model RH [illegible] Earphones housed in gray [illegible] noise attenuating [illegible]. Soft vinyl covered foam ear cushions act as acoustical [illegible]. Frequency response [illegible]-5,500 cps. Headset impedance [illegible] ohms. Six conductor cordset terminated in U-174 / U Connector [illegible] two RPL 1/3(32) Miniature Connectors for connecting [illegible] microphone. Folding mounting brackets are spring loaded [illegible] earcups press firmly against head. Military version: Headset Electrical H-154 / AIC.

3 / **HEADSET ASSEMBLY MODEL RHE 149(14)** This special purpose headset utilizes [illegible] Model RH 143R Dynamic Earphone Elements in ear enclosing [illegible] type Hypalon covered foam cushions. Headset impedance [illegible] ohms. Special cord guides attach cordset to oxygen hose of pilot's oxygen mask. Upper section of the cordset is provided with an RPL 1/3(32) Miniature Connector for attaching oxygen mask microphone. Lower end of cordset terminated in Plug U-93A / U. Military version: Headset Electrical H-149 / AIC.

4 / **HEADSET ASSEMBLY MODEL RHE 149A(14)** Designed for use in protective helmets. Has Hypalon coated foam rubber circumaural earcushions. Equipped with RH 143R Earphone Elements. Headset impedance 10 ohms. Specially coiled cordset, for attachment to the supply tube of an oxygen mask, has 5 conductors, terminated in U-174/U Connector with an RPL 1/3(32) Miniature Connector for attaching microphone. Military version: Headset Electrical H-149A / AIC.

5 / **HEADSET ASSEMBLY MODEL RHE 75C(42)** A Dynamic Headset used in pilot's protective helmets such as type P-4. Jack-in-the-box spring assembly presses Hypalon coated circumaural earcushions against head. Supplied with Roanwell RH 143R Earphones. Frequency response 100-5,500 cps. Headset impedance 10 ohms nominal. Six conductor cordset terminated in 4 contact U-93A / U Connector. Includes JJ-055 jack for connecting dynamic microphone. Military version: Headset Electrical H-75C / AIC.

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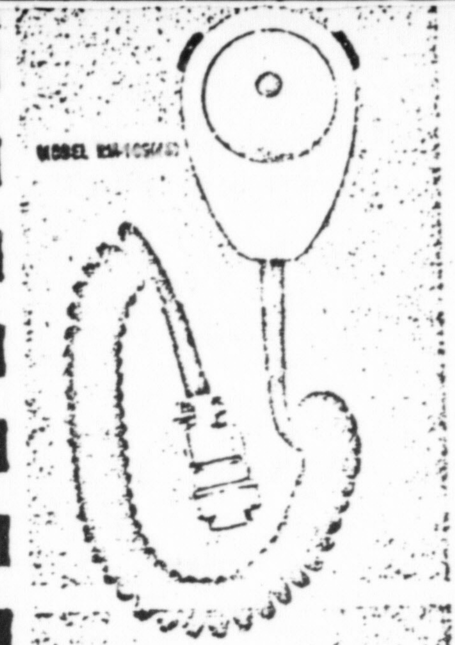
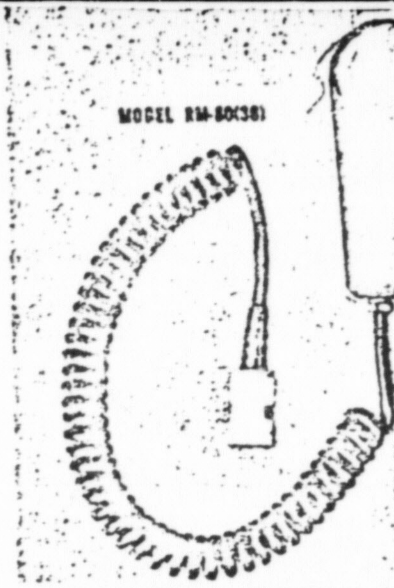
D's Disc. Exh. 2





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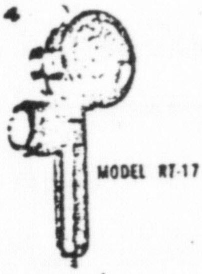

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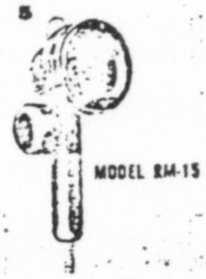

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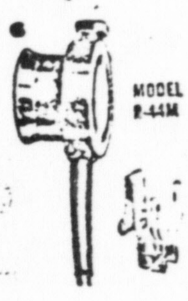

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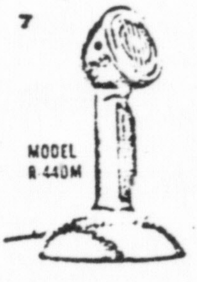

ROANWELL MOBILE (HAND-HELD) MICROPHONE AND DESK STAND MICROPHONE ASSEMBLIES

1 / **DYNAMIC, NOISE-CANCELING, MOBILE MICROPHONE MODEL RM-109(46)** This ruggedly constructed unit is a dynamic, noise canceling, hand held microphone that transmits voice communication of reliable intelligibility even when used in high ambient noise level areas. Frequency response 300-5,000 cps. Recommended load 30 ohms. Sensitivity: −18db ref. 1 mw/Newton m-2 (10 dynes/cm2) 3 conductor retrax cord, 4 ft. extended, terminated with Plug MS-3106-14S-5P and Clamp MS-3057-6. Military version: Microphone, Noise Canceling, Dynamic M-109/U.

2 / **DYNAMIC, NOISE-CANCELING, MOBILE MICROPHONE MODEL RM-80(36)** Roanwell Model RM-80(36) Microphone is built to meet all requirements of the most rugged field operations. It is blast resistant and watertight. Frequency response essentially flat from 300-3,500 cps. Nominal impedance [illegible] ohms. Sensitivity: −63db ref. 1 mw/Newton m-2 (10 dynes/cm2). Retrax cordset has 4 tinsel conductors (one conductor shielded) terminated in Plug U-182/U. Military version: Microphone, Dynamic M-80/U.

3 / **CARBON, NOISE CANCELING, MOBILE MICROPHONE MODEL R-02M** Compact and reliable. Designed specifically for noisy locations. Makes use of Roanwell Model R-CO Confidencer (noise-canceling microphone element). Nominal impedance 60 ohms. Sensitivity: −23db. ref. 1 mw/Newton m-2 (10 dynes/cm2). Two push-to-talk buttons, either one of which can be depressed with thumb or forefinger of either hand to operate switch (SPST). Black wrinkle finish. 4 conductor retrax cord, 4 ft. extended, terminated in tinned leads. Hanger is Model R-60HA.

4 / **HAND-HELD MICROPHONE MODEL RT-17** Specifically designed for aircraft use. Finish is telephone black except for anodized hang-up hook and coil spring cord protector. The switch (DPST (Military Type SW-109)) and mouthpiece assembly are readily replaceable for field maintenance. Nominal impedance of carbon microphone element 40 ohms. Sensitivity: −22db. ref. 1 mw/Newton m-2 (10 dynes/cm2). Supplied with 5 ft. 3 conductor rubber jacketed straight cordage terminated in Plug PJ-068. Military version: T-17F. Universal replacement Microphone Element (=10136) fits all Military types T-17A thru T-17F.

5 / **NOISE-CANCELING, HAND-HELD MICROPHONE MODEL RM-15** Model RM-15 is a carbon, noise canceling version of the RT-17. Designed for close talking, the RM-15 reduces background noises to a minimum, which increases the intelligibility of the desired transmission. Average noise cancellation is [illegible] db. Sensitivity: −22db ref. 1 mw/Newton m-2 (10 dynes/cm2). Ideal for use under high ambient noise conditions. Microphone impedance 40 ohms, nominal. Military version: Microphone, Carbon M-15/UR.

6 / **HAND-HELD MICROPHONE MODEL R-44M** A lightweight, dependable microphone designed to meet rigid Navy specifications. Impedance of carbon microphone element 100 ohms. Sensitivity: −24db. ref. 1 mw/Newton m-2 (10 dynes/cm2). Mounting hanger, Model R-35HA, designed specifically for this microphone. C.A.A. Type Certificate No. 1185. Military version: Microphone M-85/U.

7 / **DESK STAND MICROPHONE MODEL R-440M** Smartly styled, reliable microphone utilizes single piece die cast body. Available with Model RF-1 (carbon, 35 ohms), R-CO Confidencer (for noisy locations), dynamic pressure or dynamic noise canceling microphone elements. Accepts most of the Roanwell handset switches. Easily replaceable component parts. Military version: Microphone Carbon M-48/U.

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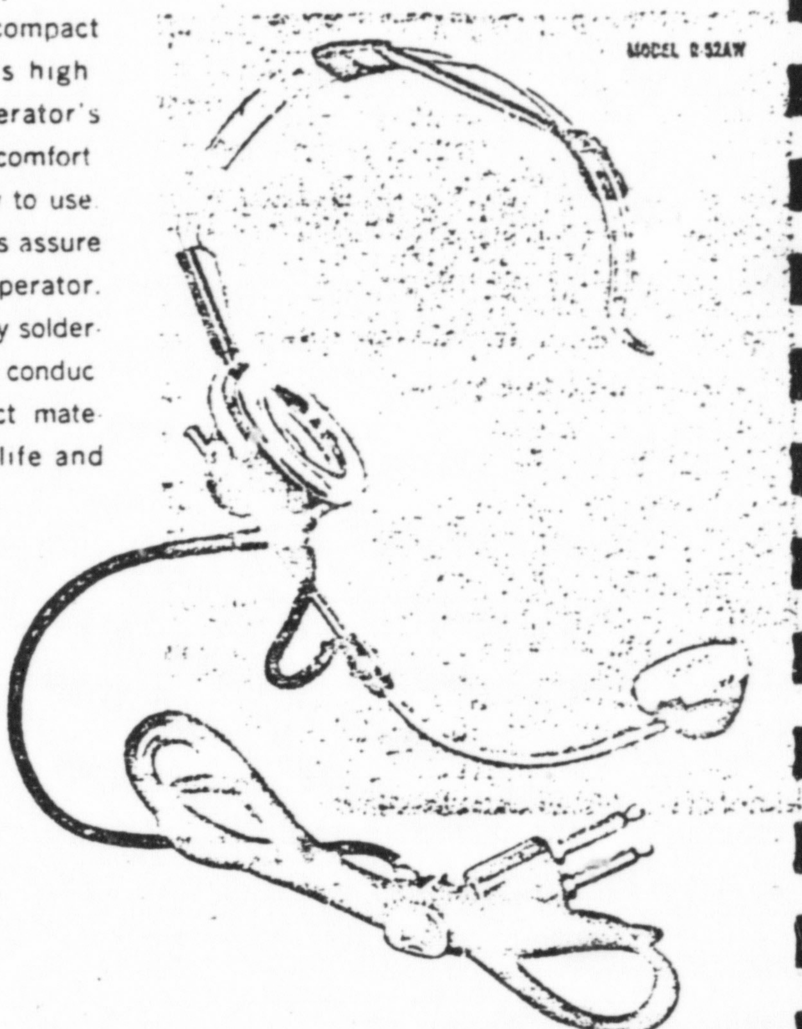
EP 3669
D's Disc. Ext. 2

cc – L. W. Clark (C, D, H + C)
L. W. Clark

ROANWELL TELEPHONE OPERATOR'S HEADSETS

The lightweight and compact design of Roanwell's high quality telephone operator's headsets makes them comfortable to wear and easy to use. Multi-adjustment joints assure a perfect fit for the operator. Such features as heavy solder-plated contacts, tinsel conductors, and high impact materials result in long life and dependable operation.



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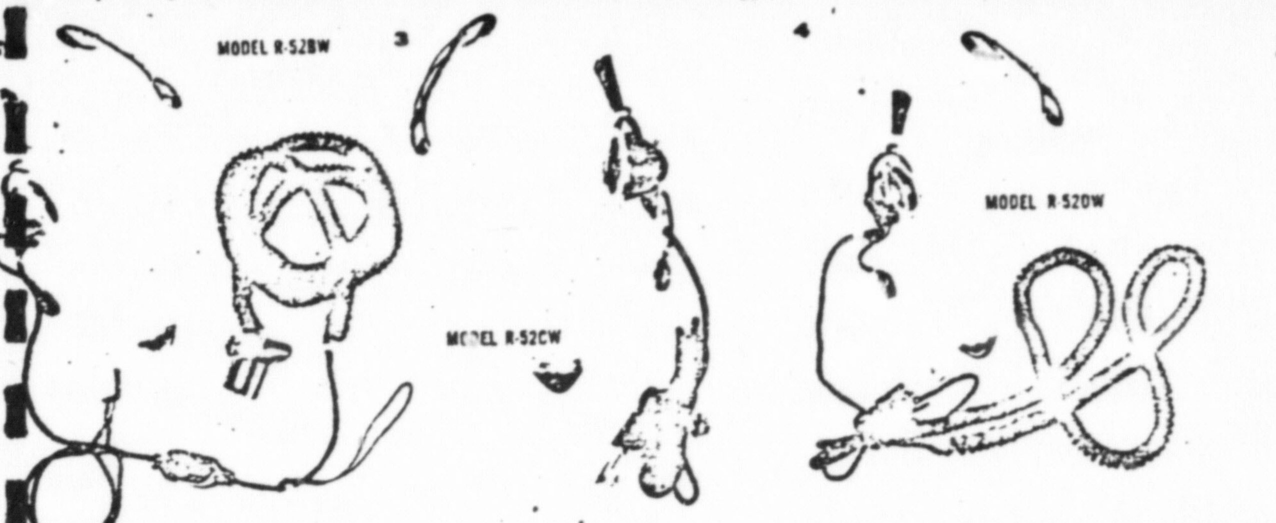

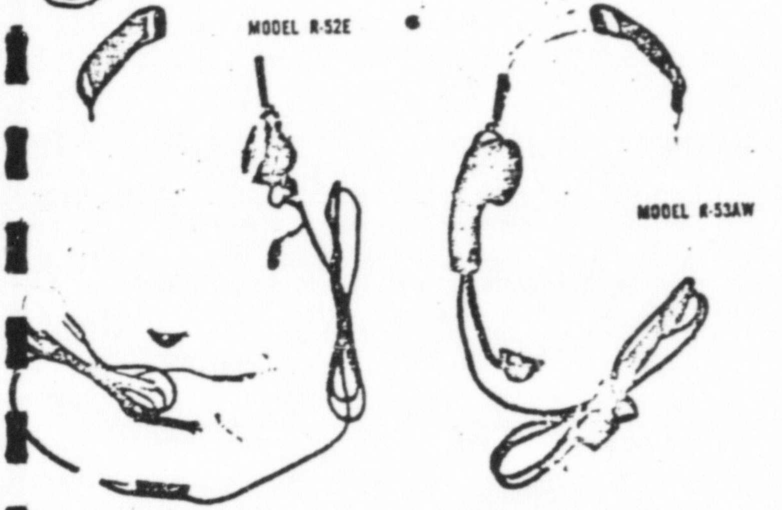

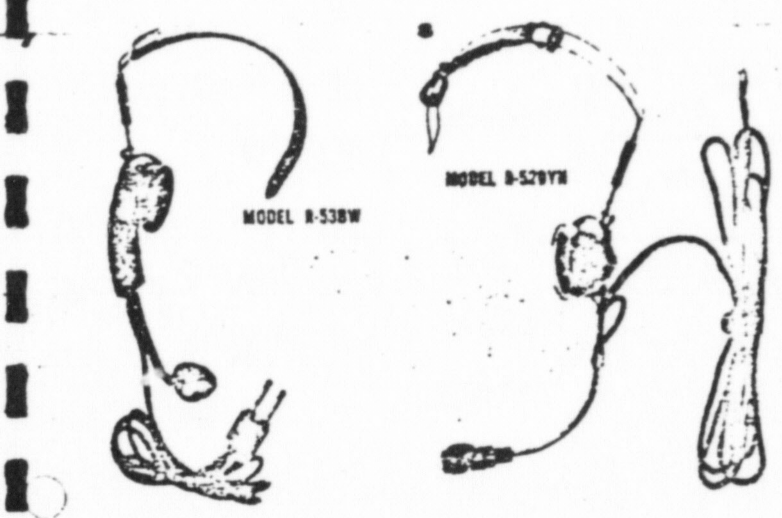

1 / TELEPHONE OPERATOR'S HEADSET MODEL R-52AW Designed for general operator's use. Weight 9.8 ounces. 5 ft. straight black nylon braided 4 conductor cordset terminated in twin telephone plug. Uses RN-1H high output Carbon Microphone Element (30 ohms) 300-5,000 cps frequency response and a RC-3 Magnetic Receiver Element (275 ohms) 100-3,000 cps frequency response.

2 / TELEPHONE OPERATOR'S HEADSET MODEL R-52BW Supervisor's headset. Equipped with 28 in. cord from headset to cut-out switch then 15 ft. retrax cord to twin plug. All cordage, tinsel, brown cotton braided. Wrist loop at switch facilitates handling cordage while moving about. Weight 11.5 oz. Uses same earphone and microphone elements as the R-52AW.

3 / TELEPHONE OPERATOR'S HEADSET MODEL R-52CW Exactly the same as Model R-52AW except uses Earphone Model RC-4 (550 ohms) Earphone Element.

4 / TELEPHONE OPERATOR'S HEADSET MODEL R-52DW Designed for use by night operators. Brown cotton braided cordset permits freedom of movement — consists of 40 in. straight cord, with wrist loop attached to 15 ft. retrax cord terminated in twin plug. Uses RN-1H Transmitter Element (30 ohms) and RC-3 Earphone Element (275 ohms).

5 / LINEMAN'S HEADSET MODEL R-52E Operator's type headset modified for use by linemen. Weight 10 oz. Black braided cordset 86 in. long terminated in 2 alligator clips. Furnished with 0.1 mfd 200 volt condenser with one terminal common to receiver circuit so that headset can be used with or without the condenser in series with the receiver circuit. Uses RN-1H Transmitter Element (30 ohms) and RC-3 Receiver Element (275 ohms).

TELEPHONE OPERATOR'S HEADSET-HANDSET MODEL R-53AW A telephone operator's headset designed primarily for Military application. With headband removed can be used as handset. Has 5 ft. straight black nylon braided 4 conductor cordset terminated in twin plug. Uses RN-1H Transmitter Element (30 ohms) and RC-3 Receiver Element (275 ohms).

/ TELEPHONE OPERATOR'S HEADSET HANDSET MODEL R-53BW Exactly the same as R-53AW except for headband and 5 ft., 4 conductor, rubber jacketed cordset.

/ HEADSET-MICROPHONE ASSEMBLY MODEL R-52DYN Especially designed for aircraft control tower application. The dynamic, cardioid, noise canceling microphone eliminates unwanted pick-up where many operators are talking simultaneously to different in flight pilots. Microphone impedance 25 ohms. Frequency response 200-5,000 cps. Uses 600 ohms Magnetic Receiver Element with frequency response of 300-4,000 cps. Cordset is approx. 7 ft. long, 4 conductor, black nylon braided jacket, terminated in eye lugs.

EP3671

542 D's Disc. Exh. 2

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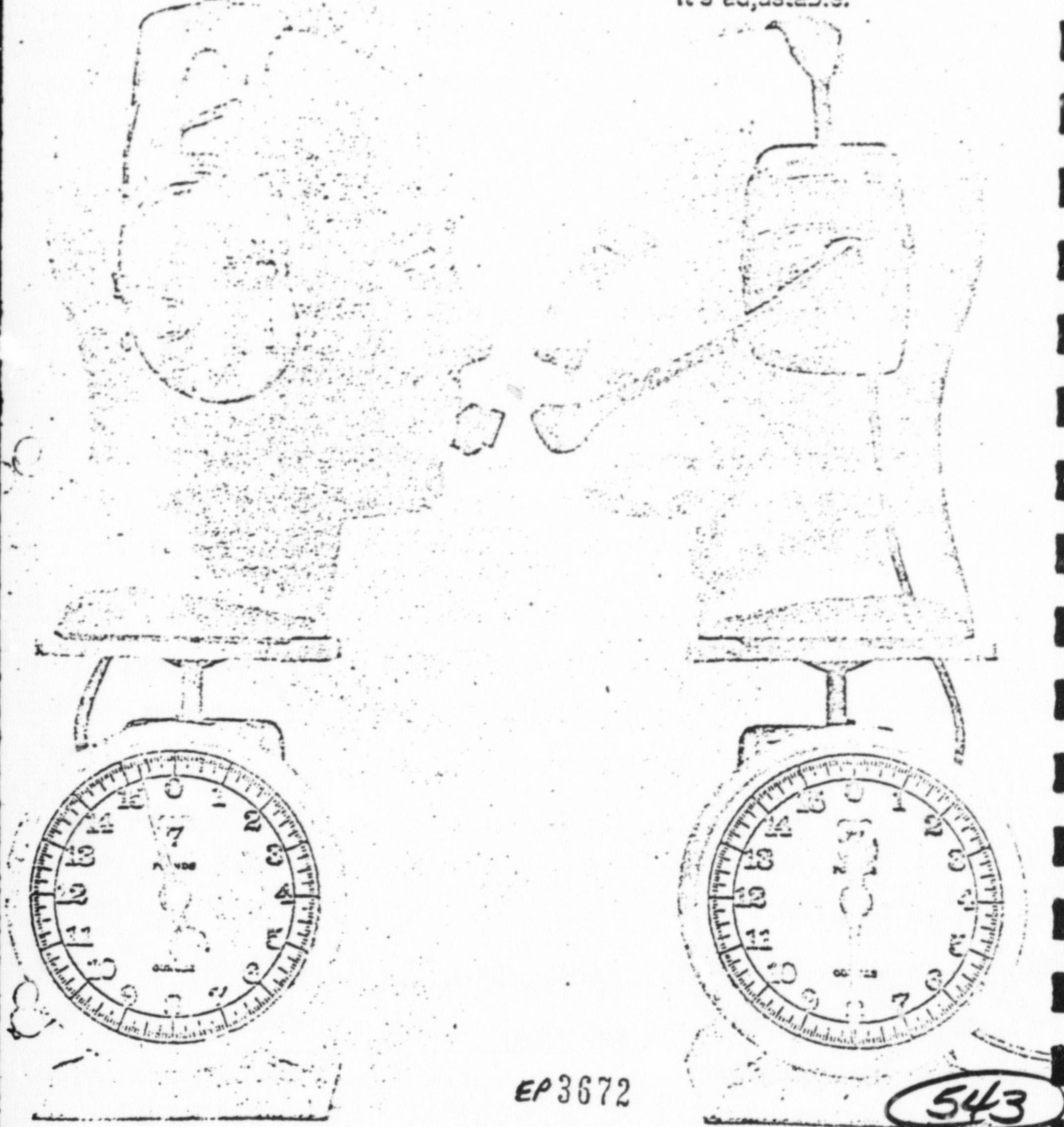
The headset you're wearing
weighs only 6 ounces?

Yes.
It's a Roanwell Lightweight.
It gives me more comfort
than ever before.
I can wear it longer
with less fatigue.
It's adjustable.



EP3672

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[..]nwell's Lightweight Headsets [O]ffer Quality, Comfort and Reliability

Roanwell's new line of Lightweight Headsets feature:

[M]AXIMUM COMFORT. As light as 8 ounces. No fatiguing weight. No [an]noying pressure: circumaural-[de]signed earcups surround the ear, do not press against it. No hardness: ear-cushions are soft, vinyl-covered, [fo]am-filled.

[R]UGGED CONSTRUCTION. Roanwell's Lightweight Headsets combine latest [st]ate-of-the-art design with modern [co]lors and styling. But more important, they are built to MILITARY AND [TE]LEPHONE INDUSTRY quality stan[da]rds. This assures you increased reliability.

Model RHM-1 Type I
Single earcup headset, no microphone

Model RHM-1 Type II
Single earcup headset, plastic boom microphone

Model RHM-1 Type III
Single earcup headset, wire boom microphone

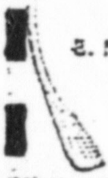
MINIMUM FATIGUE. Because of [li]ght-weight and comfortable fit, you can now wear professional quality headsets for longer periods of time with less fatigue. Proper design assures that your headset will remain in place even when you stoop or move about.

I. MICROPHONES (select one)

A. Model No. RBM-200 Plastic Boom, Noise-Canceling, Dynamic Microphone

Sensitivity:	−61 dB ref 1 mW/Nm⁻²
Frequency Range:	300 cps to 4500 cps
Noise-Cancellation:	14 dB average
Output Impedance:	5 Ohms

B. Model No. RBM-201 Plastic Boom, Noise-Canceling, Dynamic Microphone



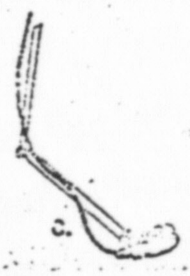
Sensitivity:	−53 dB ref 1 mW/Nm⁻²
Frequency Range:	300 cps to 4000 cps
Noise-Cancellation:	14 dB average
Output Impedance:	150 Ohms

C. Model No. RBM-101A Wire Boom, Noise-Canceling, Dynamic Microphone

Sensitivity:	−58 dB ref 1 mW/Nm⁻²
Frequency Range:	200 cps to 4500 cps
Noise-Cancellation:	18 dB
Output Impedance:	6 Ohms

D. Model No. RBM-101B Wire Boom, Noise-Canceling, Dynamic Microphone

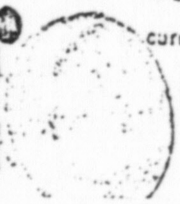
Sensitivity:	−50 dB ref 1 mW/Nm⁻²
Frequency Range:	300 cps to 4000 cps
Noise-Cancellation:	17 dB
Output Impedance:	150 Ohms



C.

D.

E. Model No. RN-1C Wire Boom, Noise-Canceling, Carbon Microphone



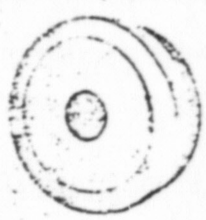
Sensitivity: −12 dB ref 1 mW/Nm⁻² with 75 mA dc current in 20 Ohms load
Frequency Range: 300 cps to 4000 cps
Noise-Cancellation: 18 dB
Output Impedance:

F. Model No. RN-1H Wire Boom, Carbon Microphone

Sensitivity: −8 dB ref 1 mW/Nm⁻² with 75 mA dc current in 20 Ohms load
Frequency Range: 300 cps to 4000 cps
Noise-Cancellation: None, pressure type microphone
Output Impedance:

II. EARPHONE ELEMENTS (specify impedance)

Model No. RE-200 Miniature Dynamic Earphone Element



Sensitivity:	105 dB at 1000 cps ref 0 dB .0002 dynes/cm² with input of 1 mW
Frequency Range:	100 cps to 4500 cps
Impedance:	20 Ohms, 150 Ohms, or 300 Ohms

Roanwell Proven Reliability

Since 1948, Roanwell has pioneered in the design and development of terminal communications equipment for defense and commerce.

These new Lightweight Headsets feature the quality, construction and performance to meet or exceed Military and Telephone Industry standards.

544

EP 3872

...quality headsets lighter than ever for less fatigue than ever, ...you can specify 500 custom designs.

24

...el RHM-2 Type I ...e earcup headset, ...no microphone

Model RHM-2 Type II Double earcup headset, plastic boom microphone

Model RHM-2 Type III Double earcup headset, wire boom microphone

SUPERIOR COMMUNICATIONS. Miniature Dynamic Earphones • Noise-Canceling Dynamic Microphones • Straight Carbon or Noise-Canceling Carbon Microphones combine to offer high intelligibility and excellent voice recognition.

You Can Design Your Own Headset

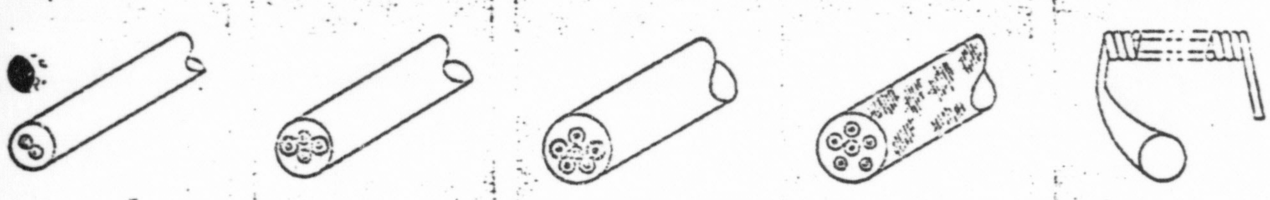
Roanwell designed this new line of Lightweight Headsets so that you may literally custom specify your own headset(s). Over 500 practical headset combinations can be constructed from the standard parts shown in this brochure.

To specify your headset, select one of the basic types of headsets from the top half of this brochure. Then from the bottom half, select the standard components that will best meet your circuit requirements. If you have any questions or need any assistance in selecting components to meet your parameters, please contact us. We will be happy to serve you.

III. LIGHTWEIGHT CORDAGE (select type needed)

Standard retractile cords come in 5 ft, 12 ft and 20 ft extended lengths.

Straight Cord



1. Brown vinyl (PVC) jacket, stranded, 2 conductor, no shielding.
2. Brown vinyl (PVC) jacket, stranded, 4 conductor, 2 shielded.
3. Brown vinyl (PVC) jacket, stranded, 6 conductor, 2 shielded.
4. Brown nylon braid jacket, stranded, 6 conductor, no shielding.

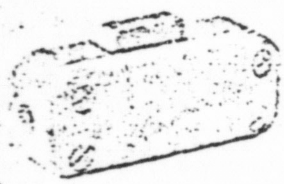
Retractile Cord

1. Brown vinyl (PVC) jacket, stranded, 4 conductor, 2 shielded.
2. Brown vinyl (PVC) jacket, stranded, 6 conductor, 2 shielded.

IV. SWITCHES (select one)

Model No. RS-22 Miniature Switch

Model RS-22 Miniature Switch is available in the following four standard actions.



A. Momentary Action
- ☐ SPDT
- ☐ DPDT

B. Locking Action
- ☐ SPDT
- ☐ DPDT

V. TERMINATIONS (select one)

Plugs:
1. TP-120
2. U-174/U
3. 289-B
4. U-77/U
5. XLR(4)11
6. PJ-054
7. PJ-068
8. Tinned Leads
9. Spade Lugs
10. Clips
11. Others

VI. TRANSAMPS

A Roanwell standard transistorized preamplifier is available to match standard telephone circuits. Transistorized preamplifiers to match any other circuit requirements can be manufactured on a custom-made basis.

ROANWELL CORPORATION
Roanwell Building
180 Varick Street
New York, N.Y. 10014
Phone: (212) 989-1090
TWX: 212-640-47..

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EP 3674

ROANWELL BUILDING
180 VARICK STREET
NEW YORK, N.Y. 10014
Phone: (212) 989-1090
TWX: 212-640-4791

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SALES REPRESENTATIVES

ARIZONA
Jewett Company
P.O. Box 172
32-B E. 1st Street
Scottsdale, Arizona 85252
Phone: (602) 945-9711
TWX: 602-949-0114

CALIFORNIA
Jewett Company
13111 Ventura Boulevard
North Hollywood, California 91604
Phone: (213) 789-8103
TWX: 213-783-3993

FLORIDA
HI-CO Associates
P.O. Box 11012
Fort Lauderdale, Florida 33306
Phone: (305) 565-1334

HI-CO Associates
P.O. Box 1317
Winter Park, Florida 32790
Phone: (305) 647-5030

HAWAII
Intelectronics, Inc.
122 Oneawa Street
Kailua, Hawaii 96734
Phone: 255-449

NEW MEXICO
COLORADO
EL PASO, TEXAS
AR/TEC, Inc.
14 East Stetson Drive
P.O. Box 727
Scottsdale, Arizona 85252
Phone: (602) 947-6364
TWX: 910-950-1294

AR/TEC, Inc.
2800 Cardenas Drive N.E.
Albuquerque, New Mexico 87110
Phone: (505) 268-3324

TEXAS
ARKANSAS
OKLAHOMA
LOUISIANA
Howell Sales, Inc.
235 S.E. 14th Street
P.O. Box 747
Grand Prairie, Texas 75051
Phone: (214) 262-5153
TWX: 214-264-2581

AUSTRALIA
Electronic Products Australia, Ltd.
P.O. Box 85
Mount Waverly
Melbourne, Victoria, Australia
Phone: 232-7120

AUSTRIA
WEST GERMANY
Heinz Cunz
Niedenau 62
Frankfurt, Au Main
West Germany
Phone: 722839

For all other areas, please contact Roanwell directly.

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...ICATIONS

...ENSE HEADSETS FOR:
...e Systems Crewmen
...cket Launch Crewmen
...ne Detector Operators
...Operators
...y Aircraft
...ound Support Crewmen
...o-Way Radio Operators

...STRIAL HEADSETS FOR:
...lephone Operators
...lephone Linemen
...actor Operators
...Radio Operators
...se Station Operators

...MERCIAL HEADSETS FOR:
...dio & TV Broadcast Production
...mmercial Jet Pilots
...ecutive Aircraft Pilots
...ivate Aircraft Pilots
...rport Ground Crewmen

...YIST HEADSETS FOR:
...Operators
... Operators
...e Monitoring

...AL-PURPOSE HEADSETS FOR:
...nguage Laboratories
...ce Consoles
...toriums
...me-Use TV (Private Listening)

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nals into a negative resistance of approximately the same value. The insertion of this negative resistance into the cable circuit results in the reduction of the actual line loss.

Gains of from 1 to 12 db in steps of 0.1 db can be obtained by using various values of resistance. The gain is also factory pre-strapped and the required resistance values are obtained by cutting away the proper straps.

North American Philips Co., Inc. 100 East 42nd St., New York, N. Y. 10017.

New "Scotchlok" UY Connector (Fig. 132). The "Scotchlok" brand UY, self-stripping, electrical connector is announced by the 3M Co. This connector is designed for telephony multi-pair splicing of two wire combinations of 22 through 26 gauge wire. The maximum wire insulation OD can be .060-inch.

The UY "Scotchlok" is one-half as long as its "brother," the UR connector.

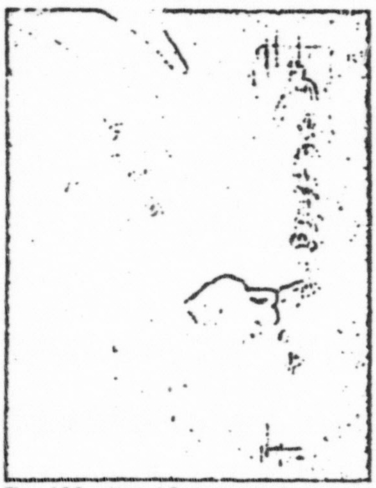

Fig. 132 New "Scotchlok" Connector.

The new UY measures .432-inch long, .230-inch high and 11/32 inch wide. It is self-stripping, gas-tight, mechanically sound and grease filled for moisture protection. It is also compatible with the "Scotchlok" brand E-9 series of crimping tools and is installed as indicated in Fig. 132A.

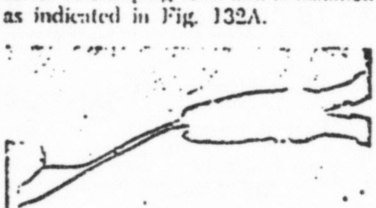

Fig. 132A The E-9 Crimping Tool.

The body of the new UY is transparent for easy inspection of the connection. The edges of the part are also flanged to permit easier wire entry. The cap and body are made of polycarbonate and the elements are tin-plated bronze. The use of this new and smaller connector is recommended where the OD of the splice bundle is a critical factor.

3M Co., 2501 Hudson Rd., St. Paul, Minn. 55119.

Local Test Desk (Fig. 133). The North Electric Local Test Desk is

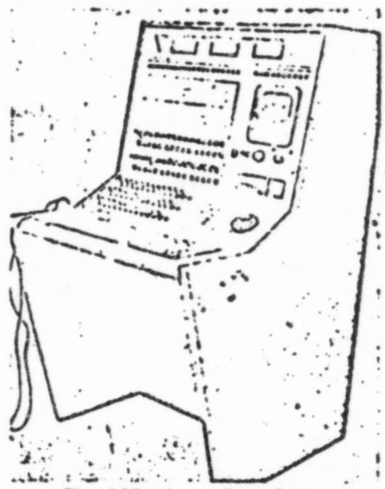

Fig. 133 Local Test Desk.

a console-test unit designed to measure local subscriber line parameters. Invaluable in fault location, this versatile test desk also serves as a dispersion point from which repair personnel are dispatched. All operations are accomplished from a comfortable sitting position. The desk is completely self-contained and need only be cabled to the central office equipment.

Visual digital display and cordless, finger-tip operation add to its versatility, and a desk-top area provides convenient record-keeping facilities.

North Electric Co., Galion, O. 44833.

Prepay Coin Trunk Test Set (Fig. 134). This test set, No. 60, is available from Crown Design & Manufacturing Corp. The compact, simplified unit tests the prepay coin trunk circuit for both "coin return" and "coin collect" functions by plugging in and flipping a switch. This set is designed for DS-31592-02 or similar equipment.

The device can be maintained near the prepay coin trunk frame in the central office for easy access. This arrangement will permit a repairman to pick up the set and quickly make a test without the need of elaborate testing equipment.

This testing arrangement may also be used on the switches as well as the T-jacks of the trunk circuits. The only additional equipment required to make this test is an adapter cable arranged to connect to the 310 type plug. The opposite end of this cable is arranged to connect to the switches.

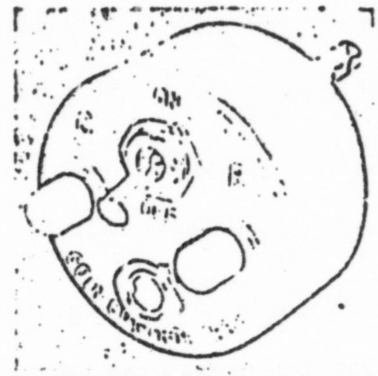

Fig. 134 Prepay Coin Trunk Test Set

This cable must also have a pendant lead with a clip to connect to the sleeve lead.

Crown Design & Mfg. Corp., P. O. Box 7343, Dallas, Tex. 75209.

Lightweight Headsets (Fig. 135). Six lightweight Special Headsets are available from Roanwell Corp. A new lightweight receiver, the RE-300 is housed in each ear cup. This receiver, an exclusive Roanwell design, weighs .3 ounce. The manufacturer states that this receiver delivers high output in a package one-third the size and one-tenth the weight of comparable units.

Background noise that interferes with communications are substantially

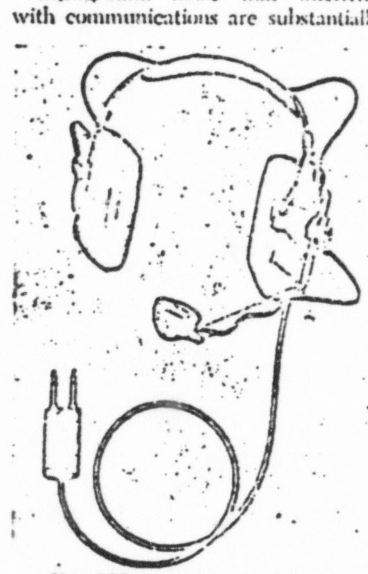

Fig. 135 Lightweight Headset.

reduced with Roanwell's noise-cancelling microphones. Two types are offered: The RN-1C carbon unit which cancels 18 db of masking background noise and the Dynamic Microphone which reduces crowd noise by 15 db.

Roanwell Corp., 180 Varick St., New York, N. Y. 10014.

Speech-Plus Data Terminal (Fig. 136). This Speech-Plus Data Terminal has been developed by Quindar Elec-

vol 175 No. 10 p 32 Tele

EP 3829

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V73 #11 p.53

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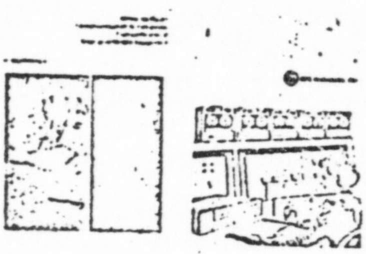
new literature

For your copy of this literature or more information, use the postpaid card opposite page 48.

Radio System Accessories

Motorola Radio Communication Accessories—Complete Base and Mobile Equipment is the name of a new 26-page brochure describing the company's line of accessory equipment designed to give added flexibility in the expansion of radio systems. *Motorola Inc., Communications Division.*

Circle number 100 on Reader Service Card



High Speed Data Transmission

Three models of data transmission equipment which will supply a majority of the requirements for use in supervisory control data accumulation, computer linkage and digital telemetering systems are described in a new 18-page booklet. Included are: Model 2056 Three Frequency Asynchronous Channel; Model 3227 coherent channel; and Model 4000 synchronous channel. *RFL Industries, Inc.*

Circle number 101 on Reader Service Card

Rectifier-Charger

Data Sheet 351.002 describes the Model M200F7 Flotrol Rectifier-Charger with thyristors. Complete specifications are included for input, output, regulation and protection, as well as fusing, wiring, ventilation, cabinet design and available accessories. *Lorain Products Corp.*

Circle number 102 on Reader Service Card

Data Network Case Histories

Benefits realized from the application of refined data communications and processing by two corporations in totally different businesses are detailed in two new eight-page brochures. One brochure describes how teletypewriter terminals provide scientists and technicians direct access to a time-sharing computer. The second brochure tells how a network of terminals links a chain of retail stores to a warehouse for faster processing of orders. *Teletype Corp.*

Circle number 103 on Reader Service Card

Tool and Accessory Catalog

A 16-page tool and accessory catalog describes a full-line of implements designed for on-the-job use with aerial lifts. More than three score items are presented for tasks ranging from strand stringing to pole-step driving. Presented in the tool section are such devices as cable guides, cable blocking dolly, lashing wire grips, hangers, rollers, safety clamps and many others. The Accessory section includes a swivel fairlead assembly, swivel bull wheel, electric tow line and transistor intercom system. *Telsta Corp., a Division of General Cable Corp.*

Circle number 104 on Reader Service Card

Data Equipment and Systems

DigiNet 1969 brochure ECD-11A illustrates an extensive line of data equipment and systems. The DigiNet line includes hard-wire and acoustically coupled data modems. The 18-page publication also covers high speed DigiNet wideband communication applications and 150 multiplex for computer time sharing. *General Electric.*

Circle number 105 on Reader Service Card

Hybrid Microcircuits

Thin-film hybrid microcircuits for D-to-A applications are featured in a new technical paper, TP 69-1. The paper gives the characteristics and applications of standard thin film hybrid microcircuits for these applications as well as data on tantalum nitride and nickel chromium resistor networks on silicon substrate used in the converters. *Sprague Electric Co.*

Circle number 106 on Reader Service Card

Electrical Product Guide

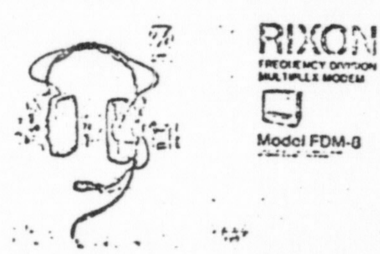
A new 16-page catalog presents condensed descriptions of electrical product lines. Each of the lines is represented by photographs and information on types available, sizes and applications. Included are conductor/collector systems and components, insulators, surface raceways, plug-in strip, underfloor raceways, service fittings, headerduct and trench-duct, conduit, floor boxes and receptacles. *H. K. Porter Co., Inc.*

Circle number 107 on Reader Service Card

Lightweight Headsets

A four-page brochure describing lightweight headsets for telephone operators and linemen is available. Single ear cup models weigh 9 ounces and double ear cup models weigh approximately 10 ounces. The headsets are manufactured in four standard configurations all equipped with soft, padded headbands: single ear cup without microphone; single ear cup with wire boom and microphone; double ear cup without microphone; and double ear cup with wire boom and microphone. *Roanwell Corp.*

Circle number 108 on Reader Service Card



Frequency Division Multiplex

Model FDM-8 Frequency Division Multiplex Modem consists of up to eight channels of full duplex communication at speeds up to 150 bits per second. The multiplex modems are discussed in a four-page brochure giving technical specification summary, features, applications and description. The FDM-8 brochure gives a typical system diagram. *Rixon Electronics, Inc.*

Circle number 109 on Reader Service Card

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Sept. 4, 19[illegible]

H. C. MOL

SCHEDULE FOR 70 SERIES HEADSET

H. C. POTTER

We have told the Bell System (via a letter to Schiavoni) and the General System (informally during a meeting in August) that we intend to introduce the 70 Series headset. Schiavoni's answer essentially tells us that we had better submit samples soon if we want to be considered. The General System personnel had told us to give them at least a drawing, general performance specifications, price and delivery by the end of September if we want to be considered by them. Furthermore, PPI has announced its intention to start shipping their new Model 50-30 by the end of the year, and we expect them to display this headset at the USITA show in October.

In view of the above factors, I have drawn up the attached tentative schedule for our work on the 70 Series headset. If we cannot do at least as well as shown on the schedule, I believe we might as well forget trying to obtain Bell System and General System approvals on our headset. As a matter of fact, I feel that we should aim for mid-November to have models submitted for Schiavoni's evaluation, since PPI has undoubtedly had models submitted to him for at least three months.

Please review this schedule against your manpower estimates and let me know as soon as possible what you think can be done.

H. C. Potter

hcp:[illegible]
att.

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Prelim. layout (#1) and plastic mockup	Completed
Layout (#2) and plastic mockup	9-12
Evaluation by management, marketing, engineering, etc	9-15
Modification of layout (#3) and 4 plastic mockups	9-22
Mockups worn + evaluated for comfort by female subjects	9-26
Modification of layout (#4)	9-30
Order soft tooling	10-10
All parts received	11-7
Engineering models assembled	11-14
" " tested	11-21
Six models submitted to Schreiman	12-15

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9-5-69

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June 20, 1969

L. R. Birdsall PPI HEADSETS

H. C. Potter

For the record, I am returning to you the following material:

1. A recently obtained Plantronics MS-50 featherweight headset.

2.. An older MS 50 headset which was apparently manufactured about 5 years ago.

3. A Roanwell-designed telephone operator's headset similar to the Plantronics MS-50.

I suggest that you keep this material together so it will be available when we want to analyse the Plantronics design further.

H. C. Potter

hcp;gw
att.

cc: H. W. Clark
R. T. Ennis
H. C. Mol

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R 70 A Recommendation 6/25/70
R.L.44

ROANWELL
CORPORATION

31

DATE June 6, 1969

TO FILE

SUBJECT DISCUSSION OUTLINE: STRATEGY RE PPI

FROM H. C. Potter

REF.

COMPANY CONFIDENTIAL

A. Significant factors -

1. New "2nd generation" headset - must find out what it is -- soon.

2. PPI/WE now have cross-license agreement -
   a. Effect on 61A patent situation? Why W.E. still want to be indemnified by Roanwell?

   b. Reference to transducer technology - PPI gearing up to make transducers?

   c. Entirely possible PPI gearing up to make 61A and 60A on cross-license, too (with either own Transducers or from Knowles, etc.).

3. W.E. offered PPI contract for new lightweight headset in December - What were circumstances? Implications?

4. W.E. 61A design is up in the air -
   a. How serious is situation?
   b. What is likely outcome?
   c. What can Roanwell do to help?

B. Sources of information -

1. Customers

   a. W. E.
      NYC Purchasing
      Indianapolis
      Supplies & inspection

   b. AT&T
      NYC Headquarters
      Operating companies

   c. BTL
      New Jersey
      Indianapolis

   d. Other
      (1) FAA (3) ITT/VAFB (5) Airlines (7) Continental
      (2) NASA (4) OEMs (6) Gen'l Tel. (8) United
      (9) Graybar

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B. 2. Suppliers

a. Knowles
b. Tibbitts (?)
c. G.E. (Semiconductor)
d. Litton (PC Bds)
e. Tooling people - Ultrasonic welding, wave soldering, etc.
f. Cordage suppliers

3. Employees

a. Engineers
b. Salesmen

4. Media

a. Santa Cruz newspaper morgue
b. Bay area newspaper morgue

5. Private Investigator (?)

6. Financial community
a. Banks
b. Analysts & brokers
c. Acquisition firms

7. <u>Recent unsuccessful acquisition candidates</u>

Proctor, Pulsecom, Ostreicher. (Lynch).

8. Consultants ("surveys").

Wm. E. Hill

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HCP:bc;6/6/69

(61A)

cc - L. W. Clark (C, D, H + C)
L. W. Clark } with copies of
H. C. Mol } patent 33

D. W. Powers

I have reviewed briefly the copy of PPI/Hutchings Patent 3,548,118 which was sent to us on 1-20-71 by Les Clark.

Attached are my sketchy notes, which we can discuss at your convenience.

Unless this is strictly a "design" patent, I'm very surprised that it was allowed — particularly in such a short time.

Our R70A over-the-ear design has some features in common with the PPI/Hutchings design, but I frankly don't think we have much to worry about — since most of the PPI claims seem to have been pre-dated. However, we should check this with Les Clark when we (shortly) proceed to discuss design patents for our R70A + R71A.

[signature] 1-22-71

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PPI Patent 3,548,118 (Hutchings) 34

"Design" or "regular" patent — appears to be "design" patent

Filed 7-3-69, Patent Issued 12-15-70 (17 months) — very fast ?

Possibly new:

1. Behind-the-ear (but common in hearing aids!)
2. Method of attaching removable ferrule (containing ball-and-socket) to housing (common in many mechanisms).
3. Over-the-ear hook (common in hearing aids).
4. Counter-balancing torques for stability

Not new:

1. Ball-and-socket adjustment of microphone (BTL)
2. Telescoping voice tube (BTL)
3. Flexible receive tube + eartip (earlier PPI, plus hearing aids).
4. Cable secured to housing (whether to back or any location!).

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Ken
7-10-70

H.C. Mol

70A

cc. H.C. Potter
R.T. Ennis
R. La Marche

I felt that perhaps it would be appropriate to record the agreements reached in connection with the 70A design philosophy review which we had last week.

1. That there is no particular merit in making the over-the-ear portion of the molded case thinner than PPI and that the detachable boom would be desirable. If it can be readily be accomplished, it might be desirable to make the two (PPI and Roanwell) boom assemblies interchangeable. (However before this could be "exploited" a comparison of the performance would be required).

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2. The "lower hook" would be retained and an alternate would be included as part of the 70A "package"

to ensure coverage of male subjects. It was also agreed that the (metal) tube carrying the hook would be kept as short as practical. This would be desirable for comfort, and less appearance if users elect not to employ the hook i.e. Users may prefer to forgo the extra stability which the hook provides if they determine it is acceptable for their particular application(s) sans hook.

3. Since it is desirable to use a common (Rockwell version) of the amplifier for the R61A, R70A, R71A, and since there may be some restrictions on placing the "diode/varistor" in the R61A capsule, it was agreed that this element could be placed on the amplifier terminal board. However it is more desirable to have this associated with the transducer and so we will keep our options open and leave the space available in the 70A (and 71A) capsule. This seems appropriate because

no significant space saving is effected in the 70A by omitting provision for the "diode/varistor" and, further, if we are fortunate enough to get AT&T to adopt either the 70A or 71A they undoubtably will want the varistor in the capsule.

(NOTE – MR POTTER has also requested that an evaluation be made of the cost implications of putting the "diode/varistor" on the amplifier terminal board)

I should record our keen disappointment that the 70A and 71A cordlets are not directly interchangable – since this complicates both the customers' inventory problems and our own, and weakens significantly the "commonality of parts" argument. However I am assured by Mr LaMarche that there is no practical, economic way to accomplish direct interchangability – so we must live with it

It is my understanding that resolution of the above items allows Engineering to finalize the design and that we will then proceed to finalize the tooling drawings and place parts on order.

By copy of this memo I am requesting Mr Potter to consider the possibility of also building short run temporary tooling (upon completion of the engineering layout drawings) since otherwise we will be running over 2 months behind on the delivery of 70A samples as promised to General Telephone and others.

[signature]

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Comparison of PPI Starset and R/C 70A

1) Pivot point on PPI unit permitts unit to sit high up on ear as opposed to R/C 70A unit which is low-slung behind ear.

2) PPI unit has more adjustment in voice-tube than R70 A due to placement on ear (item #1) and longer voice tube.

Friction slide on voice-tube (PPI) smoother than 61A type.

Voice-tube socket Assy (PPI) smoother action than 61A.

Weight of PPI UNIT 16.5 grms. LESS CORDSET
" " R70A MODEL 17 grms. LESS CORDSET

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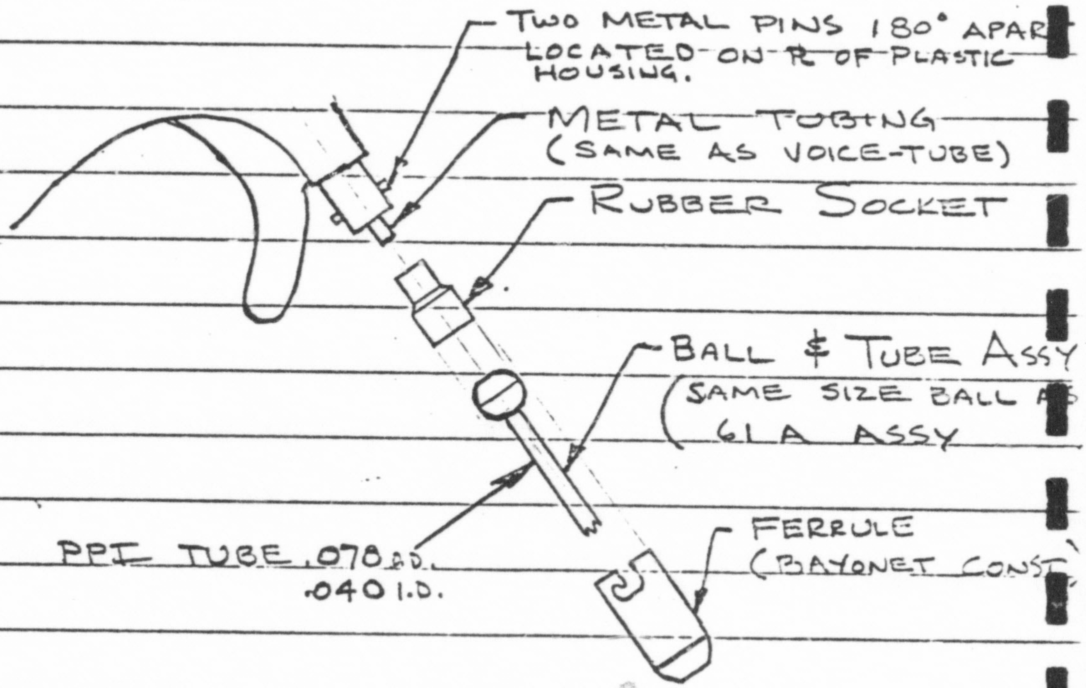
Construction of Voice-Tube Socket Assy
PPI Unit



Individual Parts PPI Unit

a) Rubber Socket

b) Ferrule

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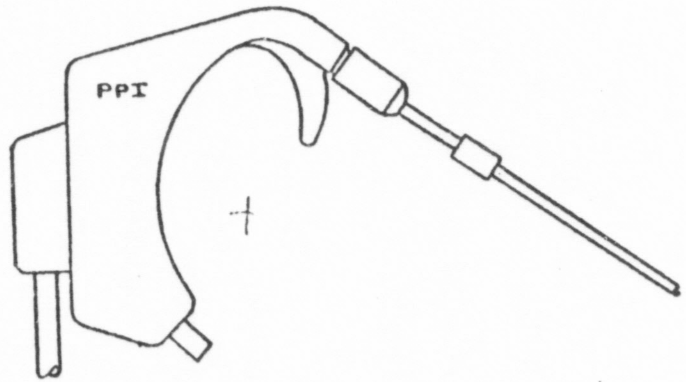

PPI STAR-SET

5-27-70

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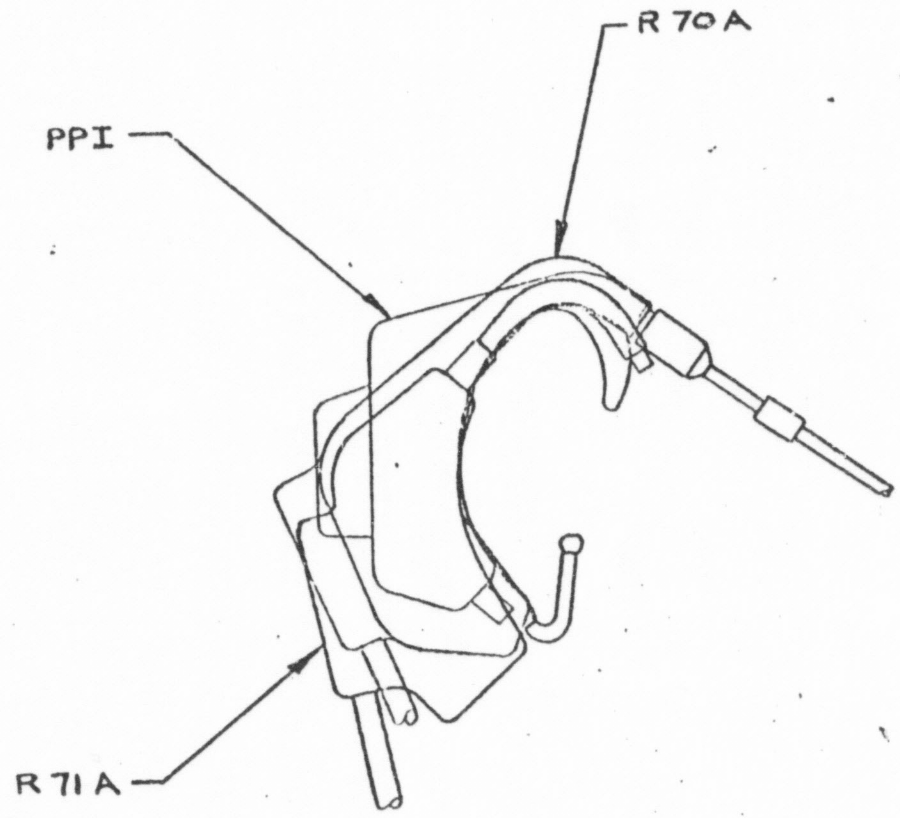
H.W.Clark



OVERLAY OF PPI AND R/C UNITS 42

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H.W.Clark

2.

R70 A SHAPE

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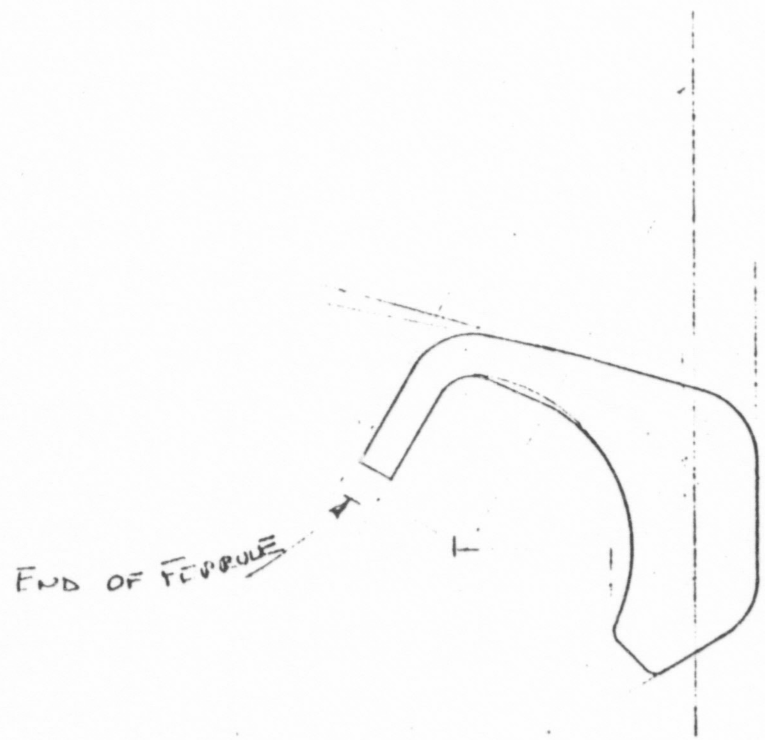
OBSOLETE
6-3-70



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R70A Recommendation

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R.L. 44

(1) Ear-hook, adjustable needed to provide stability and fit on female and small male ears

(2) Variations needed in size of ear-hooks to fit large male ears.
  a) R71A size hook to fit female and small male ears (30%) (small hook)
  b) Longer hook (.200 max. over 71A hook) fits approx 70% of males, & all females
  c) Supply both size ear-hooks with instructions for usages. For males, which large ear-hook fails to fit recommend no ear-hook be used.

(3) Small fixed hook over the ear needed for stability when under the ear hook is not used and for locating mic-boom (Location critical on small female ears).

(4) Use of adjustable ear-hook will add additional bulk to rear section of headset.

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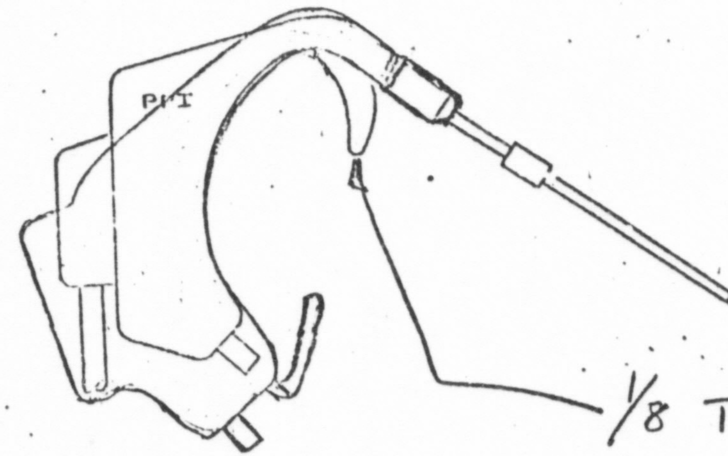
(5) Metal hook for mounting on eyeglasses.
(6) Shorten upper hook on model used to fit ears



1/8 THK
BLENDED INTO
EXISTING HOUSING

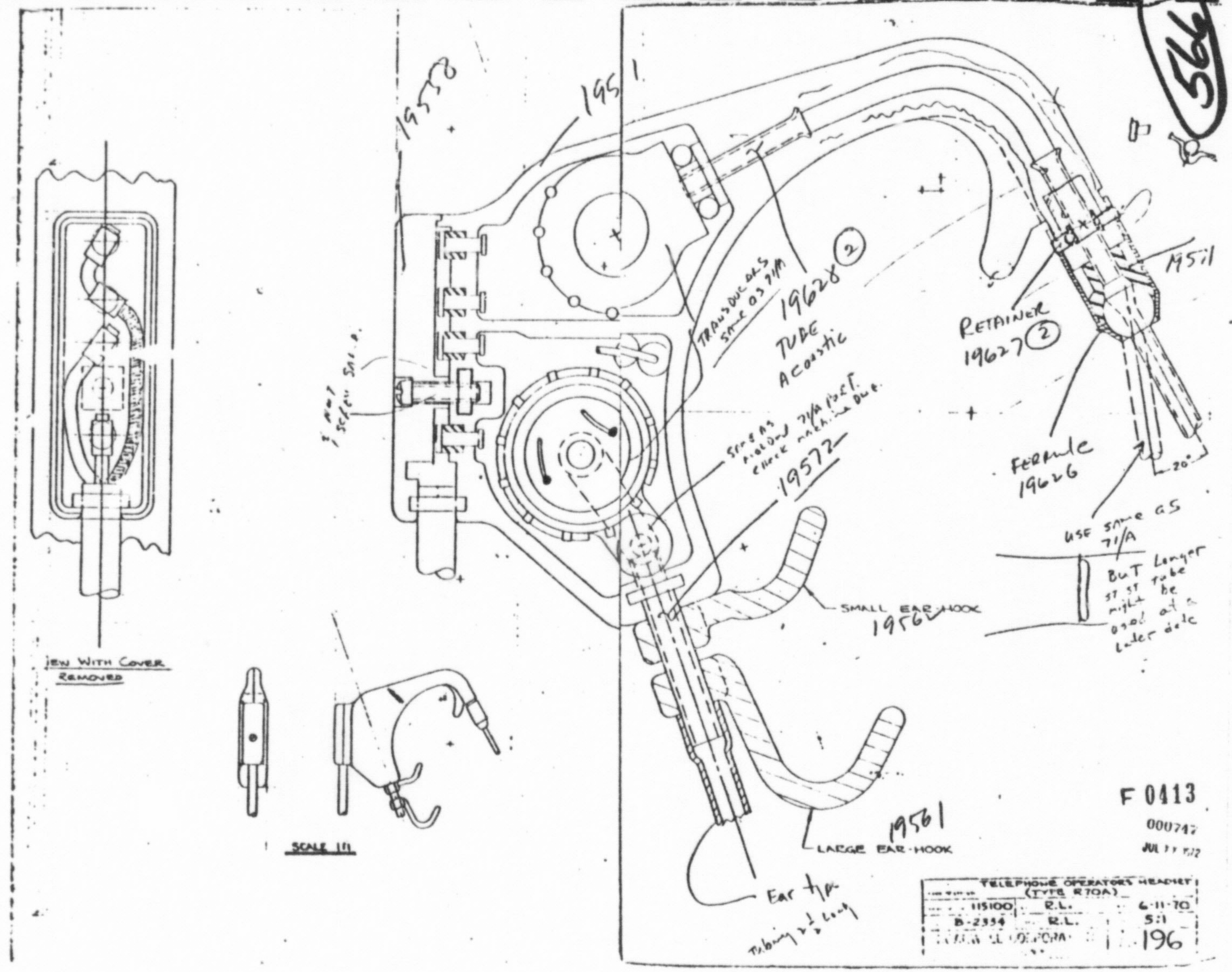
45

PPI STAR-SET
5-27-70

565

F 0405
000775
JUL X X 1972

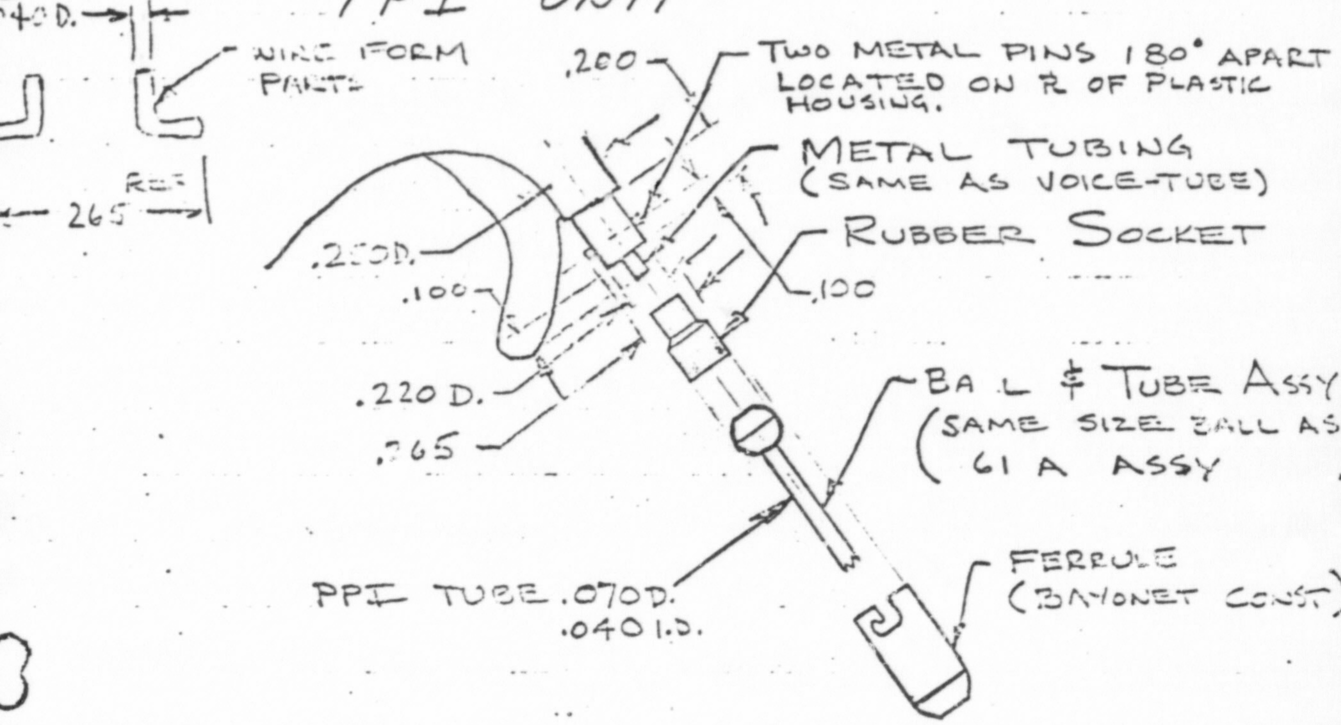
46



VIEW WITH COVER REMOVED
SCALE 1:1
19558
1951
TRANSDUCERS SAME AS 71A
19628 (2)
TUBE Acoustic
RETAINER 19627 (2)
1951
FERRULE 19626
USE SAME AS 71/A
BUT Longer st st tube might be used at a later date
SCREWS AS PLATED 71/A PORT. CHECK MACHINE DWG.
19572
SMALL EAR-HOOK 19562
19561
LARGE EAR-HOOK
Ear tip
F 0413
000747
TELEPHONE OPERATORS HEADSET (TYPE R70A)
115100
R.L.
6-11-70
B-2334
5:1
196
566

5/27/70
47

Construction of Voice-Tube Socket Assy
PPI Unit



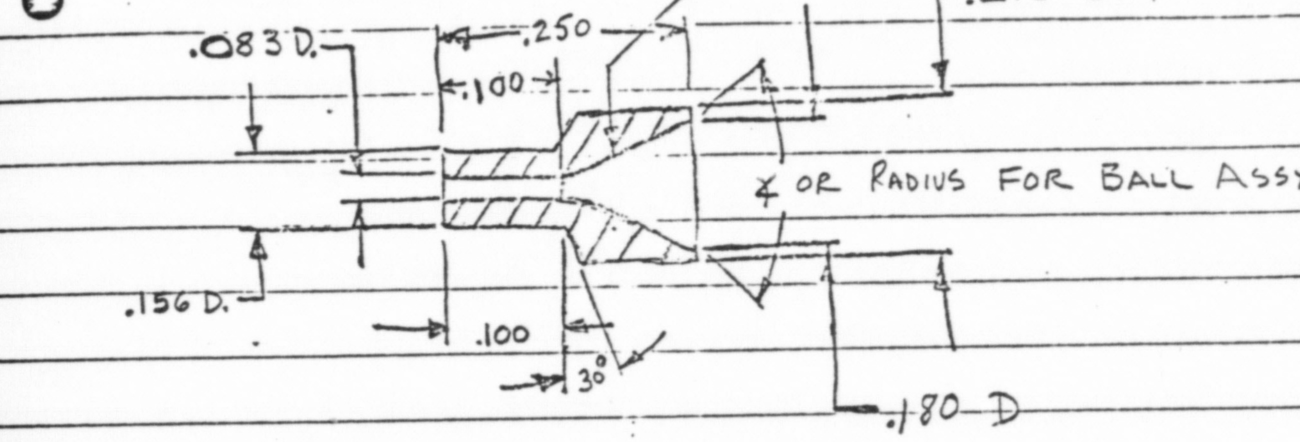
INDIVIDUAL PARTS PPI UNIT

1) Rubber Socket
2) Ferrule

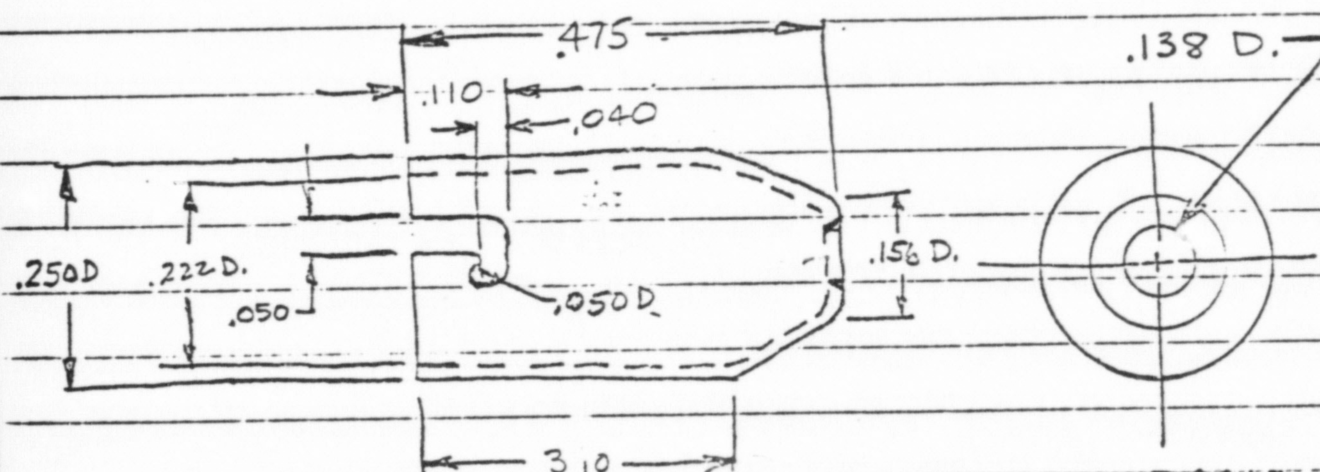
PPI PARTS

5/27/70
48

RUBBER SOCKET

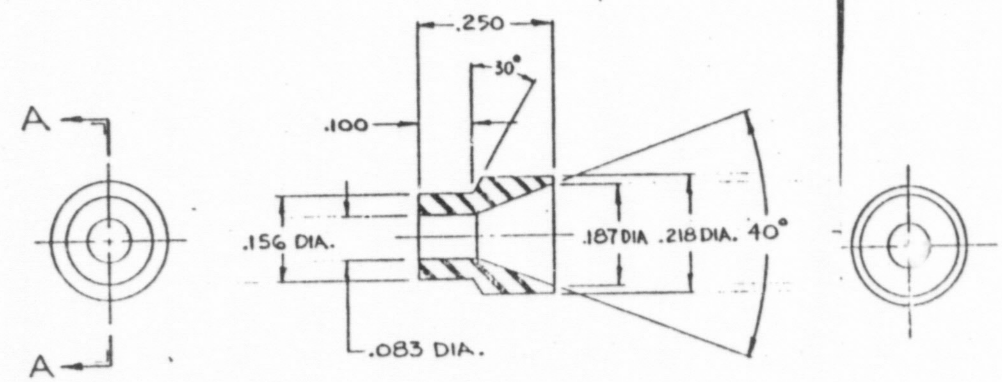


b) FERRULE



49

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	X	RELEASED FOR QUOTATIONS	4-12-71	



SECTION A-A

NOTES

1- ALL CORNERS SHOWN SHARP MAY HAVE .005 INCH RADIUS UNLESS OTHERWISE SPECIFIED.

2- REMOVE ALL FLASH.

3- MATERIAL	PARTS BY WT
ENJAY EPR 404	100 PARTS
ZINC OXIDE	5 PARTS
SRF BLACK	35 PARTS
DI CUP 40 HAF	8 PARTS

SHORE HARDNESS 49
OVEN TREAT 12 HOURS AT
100° C TO REMOVE ODOR.

ITEM NO	REQ'D	CODE IDENT	PART NO OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES

PARTS LIST

115106()	
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES FRACTIONS ± — ANGLES ± 1° 3 PLACES DECIMALS ± .005 2 PLACES DECIMALS ± —

MATERIAL ‡ 80642 RUBBER (SEE NOTE #3)

CONTRACT NO.

DATE

PREPARED		4-12-71
CHECKED		
ENGINEER		

ROANWELL CORPORATION
NEW YORK N.Y.

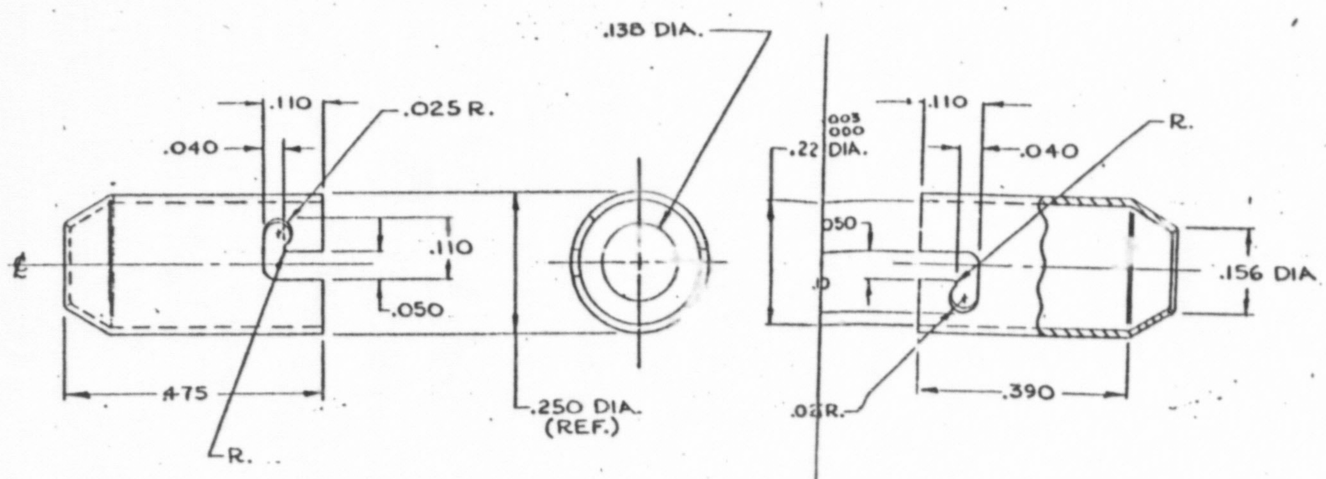
SOCKET

SIZE	CODE IDENT NO	DRAWING NO
B	82372	19571

SCALE 5:1 SHEET

50

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	X	RELEASED FOR QUOTATIONS.	2-25-71	



NOTES
1- REMOVE ALL SHARP EDGES AND BURRS.
2- BRASS SHEET .014 THICK ALLOY #8 (CA 260) 1/4 TO 1/2 HARD.
3- ROANWELL SPEC. 3924 (BRIGHT NICKEL PLATE .0002 MIN. THICKNESS).

ITEM NO	QTY REQ'D	CODE IDENT	PART NO OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES	DWG SIZE

PARTS LIST

	115100(1)
NEXT ASSY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONS ± — ANGLES — 3 PLACE DECIMALS ± .005 2 PLACE DECIMALS ± —

MATERIAL: SEE NOTE #2

FINISH: SEE NOTE #3

CONTRACT NO.

DATE

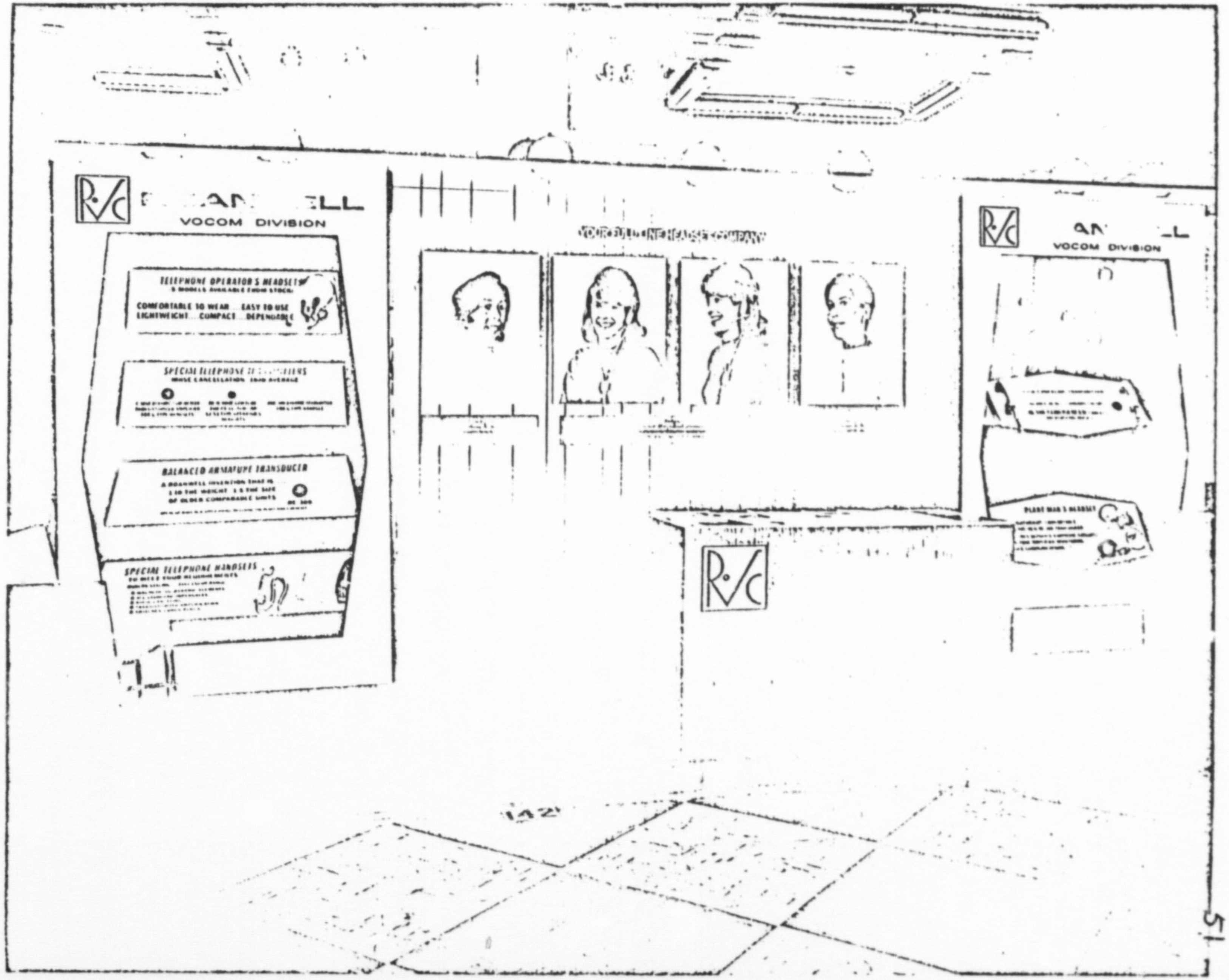
PREPARED	R.L.	2-25-71
CHECKED		
ENGINEER		

ROANWELL CORPORATION
NEW YORK N.Y.

FERRULE

SIZE	CODE IDENT NO	DRAWING NO
B	82872	19626

SCALE: 5:1 | SHEET:


VOCOM DIVISION
TELEPHONE OPERATOR'S HEADSETS
COMFORTABLE TO WEAR ... EASY TO USE
LIGHTWEIGHT ... COMPACT ... DEPENDABLE
BALANCED ARMATURE TRANSDUCER
SPECIAL TELEPHONE HANDSETS
VOCOM DIVISION

51

571

F0495

52

9954-10

DORE STUDIOS INC.
PHOTOGRAPHY
MIAMI BEACH, FLA. 33141
CALL UN 6-1457

F0496

001443

JUL X X 1972

OCT. 1969

522

Co. Conf.

Dictate

53.

Intelligence Re PPI

Target: June 30

Objective: Detailed description of PPI's new "2nd generation" lightweight headset referred to in 3rd quarter report. Pictures and/or sketches if possible. Name of 'major customer' evaluating headset. Intended market and application (Bell vs Independents, C.O. vs PBX, Telephone vs aviation/FAA). Type of transducers and supplier (Knowles or PPI). Schedule of introduction and production. PPI's intention for this headset vis à vis 61A.

Assignments:

✓ 1. (HCM) - Interview engineer
2. (HWC) - Survey FAA (via Whitney)
3. (HWC) - Request help from Puerto Rico Telephone and Allied Telephone
4. (HWC) - Ask W.E. Supplies and Inspection
5. (HWC) - Survey by Dickerson and Cowell
6. (RWH) - Ask Wm. E. Hiss for advice regarding approaches to use

F 0500

001549

573

JUL X X 1972

POSITIONING:

Affirmative Designs

f PPI 54

POTTER

BERNARDI GOT TALKED TO

DIDN'T WANT TO PURSUE

CONFIRMED NO TRANSDUCER DESIGN.

AT PPI. BUT IS WORKING ON

NOISE CANCELLING TUBES ETC.

GAVE NEW PROSPECT WHEN ASKED

AUSTIN BROWNS PRESENTLY LTV

RESEARCH IN L.A.

GOOD R&D man. WORKED FOR "years"

F 0504

ON MICROPHONE DESIGN AT SURE BROS.

DO WE WANT TO PURSUE? 574 001540

JUL X X 1972

Affirmative Designs

Dee: Pot(?)...

ROANWELL
CORPORATION

55

DATE July 24, 1969

TO H.W.Clark

cc: R.W.Howell
R.E.Anslow
L.R.Birdsall
H.C.Mol
R.T.Ennis √

SUBJECT INTELLIGENCE ON PACIFIC PLANTRONICS

FROM H.C.Potter

REF.

First let me congratulate you on getting the first real concrete information on Plantronics' new MS50-80 "behind the ear" headset! Also relay my thanks to our friend in Chicago, and let him know that we will be happy to return the favor some day.

This additional intelligence on the MS50-80 now raises some additional points and questions:

1. PPI says that they intend to have the new headset KS'd, and that it will be available "through your local telephone company later this year". If it is indeed being evaluated in regard to a possible KS approval, it would seem that we might be able to get some additional information (unofficially, of course) through some of our Western Electric and AT&T contacts. This could also mean that the "major customer" evaluating the new headset, as mentioned in PPI's news release, might be the Bell System rather than FAA, NASA, etc.

2. Several technical questions remain unanswered in the data we have received thus far:

   a. Their literature says "the basic elements of the MS50-80 were developed for astronauts in the U.S. aerospace program. A rugged headset, it is dependable even under constant use." These statements would seem to imply that they are using new, more rugged elements in this headset than the old MS50.

   b. They mention an "automatic switch-gain control" that is activated entirely by sound, and automatically reduces volume when no one is speaking. This sounds like the feature incorporated in the G1A amplifier.

   c. No mention is made of the location of the amplifier. It is not part of the clothes clip (as it was in the MS50), so I suspect it is in the plug. At least it does not appear that the capsule is large enough to contain an amplifier, unless it is an I.C.

F 0537

575 002180

cont'd.

SKETCH - 3

Dee: Pot(?)...

d. The literature mentions an "extremely lightweight cord".

e. The "strain relief clip" and lanyard used with the MS50-80 appear to be much more practical and less expensive to manufacture than the locket and lanyard assembly used by Western Electric on the 61A.

f. It is not entirely clear in the literature whether the headset is intended to be worn with either ear, or just the left ear. They say that "wearing the unit on the left ear is usually more convenient for right-handed people - the cord then hangs on the left, out of the way." From this I would gather that it is possible to wear the unit on the right ear as well.

3. In regard to applications, PPI's news releases state that the prime markets are business-oriented users, such as stock-brokers, purchasing agents, personnel administrators, etc. However, the person at PPI with whom our friend talked said that the new headset is intended for use in both central offices and PBX applications.

I believe that we should continue our search for additional data on this headset, specifically to obtain answers to some of the questions raised by the above points. I assume that you and Bob Ennis will take the necessary action to get something started.

This raises a question implied in my June 6, 1969 memo entitled "Recommendations on Competitor Intelligence". In this memo I suggested certain information that we should try to obtain on all important customers, and I also raised the question as to which department and individual should be responsible for obtaining information such as this on our competitors. Although it seems logical that the Marketing Dept. have this responsibility, we are also in the process of discussing ways of unloading some of these non-selling activities from the salesmen so that they can spend more time in direct selling activities. I would like to receive your suggestions, following which we should discuss this at one of our weekly operations meetings.

H. C. Potter

F0538

002181

576

hcp;gw

LAYOUT No 9

57

PACIFIC
PLANTRONICS
INC.

POST OFFICE BOX NO. 635
SANTA CRUZ, CALIFORNIA
TELEPHONE (408) 426-5058

July 10, 1969

Mr. Gene E. Allen
Middle West Service Company
69 West Washington Street
33rd Floor
Chicago, Illinois 60602

Dear Mr. Allen:

Thank you for your inquiry regarding our new MS 50-80 light-weight headset. The unit will be made available through your local telephone company later this year.

May I suggest you contact your telephone business office for additional details. Thank you again for your interest.

Sincerely,

PACIFIC PLANTRONICS, INC.

Grant Van Meter

Grant Van Meter
Sales Administrator

GVM:vk

Enclosure

F0539

002173

577

LAYOUT No 9

41

58

A SPECIAL SHAREHOLDER MESSAGE

578

PACIFIC PLANTRONICS, INC.
P.O. BOX 635
SANTA CRUZ, CALIFORNIA 95060

TO OUR SHAREHOLDERS:

Two weeks ago, your company announced an important new product development—an ultra-lightweight telephone headset worn behind the ear, eliminating the need for a headband. We consider this new unit, designated the model 50-80, as perhaps the most significant product ever offered by Pacific Plantronics.

It represents two and one-half years of research and development effort and incorporates a number of significant engineering advances over our original model 50 (which itself has been through a complete redesign since introduction in 1963). Most important of all, it opens a new and very large marketing area for us.

The model 50-80 has been designed as an office convenience product, and will be aimed directly at the estimated 6.7 million business-oriented users who spend a substantial part of each working day on the telephone. This market includes stockbrokers, purchasing agents, personnel administrators, many doctors and lawyers, and salesmen in virtually every phase of business.

The model 50-80 will operate off a standard desk model telephone equipped with a jack connection, as well as in conjunction with an office switchboard. Its user will have both hands free while talking, and will be able to move about within a ten-foot range of the connection.

EP 005700

Question – Method applied for

42

For individuals whose business involves making records, writing orders and instructions, and referring to documents during the course of a conversation, the model 50-80 will be a uniquely flexible, convenient and comfortable instrument (weighing less than one ounce).

Pacific Plantronics today is the largest supplier of lightweight headsets to Bell System and other telephone utility customers. There are approximately 500,000 business switchboards operating today, some 40 percent of which are equipped with our model 50.

This is a substantial market, but the office convenience market is a far larger one. Even with a much smaller percentage penetration, the volume of business available to us could be much greater.

Currently, production models of the new 50-80 headset are undergoing consumer acceptance evaluation. The product will be offered to the Bell System, the General Telephone System, United Utilities and other independent telephone systems for use by their subscribers. It also has many promising applications in the fields of commercial and private aviation, and radio communication generally.

We expect to have the new headset in volume production at Santa Cruz by the end of the current year. We also look for European production under license in 1970.

In the world market, incidentally, we now have a most significant and capable partner as a result of a long-term distribution agreement (covering our existing model 50 headset) recently concluded with the L M Ericsson Telephone Company of Sweden. Ericsson is represented on all continents by manufacturing or sales affiliates and will act as our exclusive distributor in much of Western Europe, Africa and South America, and some parts of Southeast Asia.

Meanwhile, I am most pleased to report to you that, while our audit for the year ending May 31, 1969 has not been completed, excellent results are anticipated. Sales will be in the neighborhood of $9 million, a record volume and an increase of almost 35 percent from last year. We expect earnings will improve approximately 50 percent.

Product literature on the model 50-80 will be available shortly. If you would like some of this material, please write to me.

Sincerely,

C. Graham

COURTNEY GRAHAM
President

July 7, 1969

579

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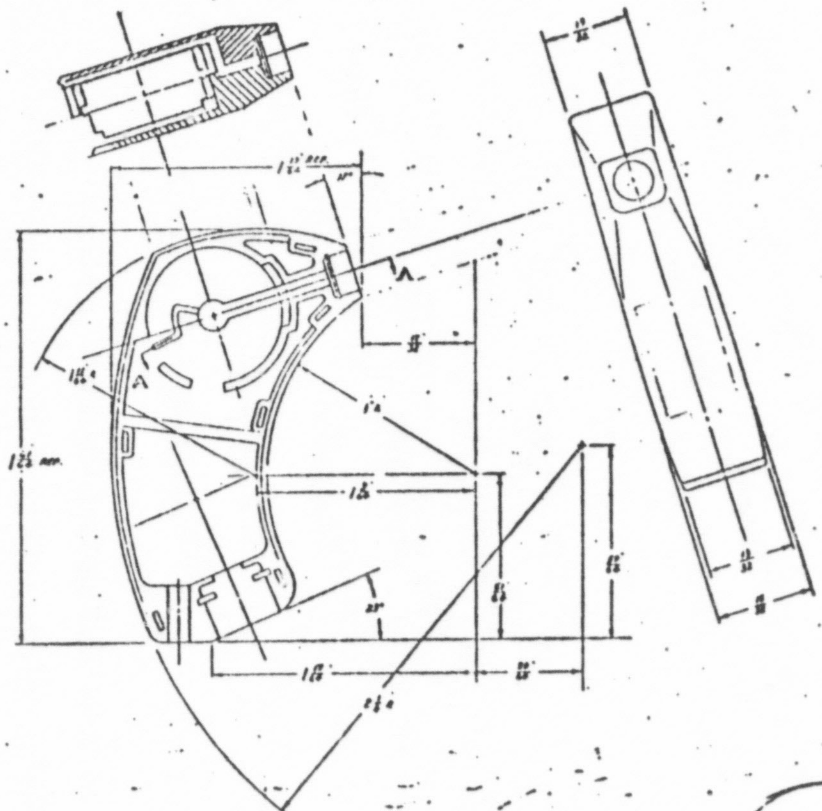
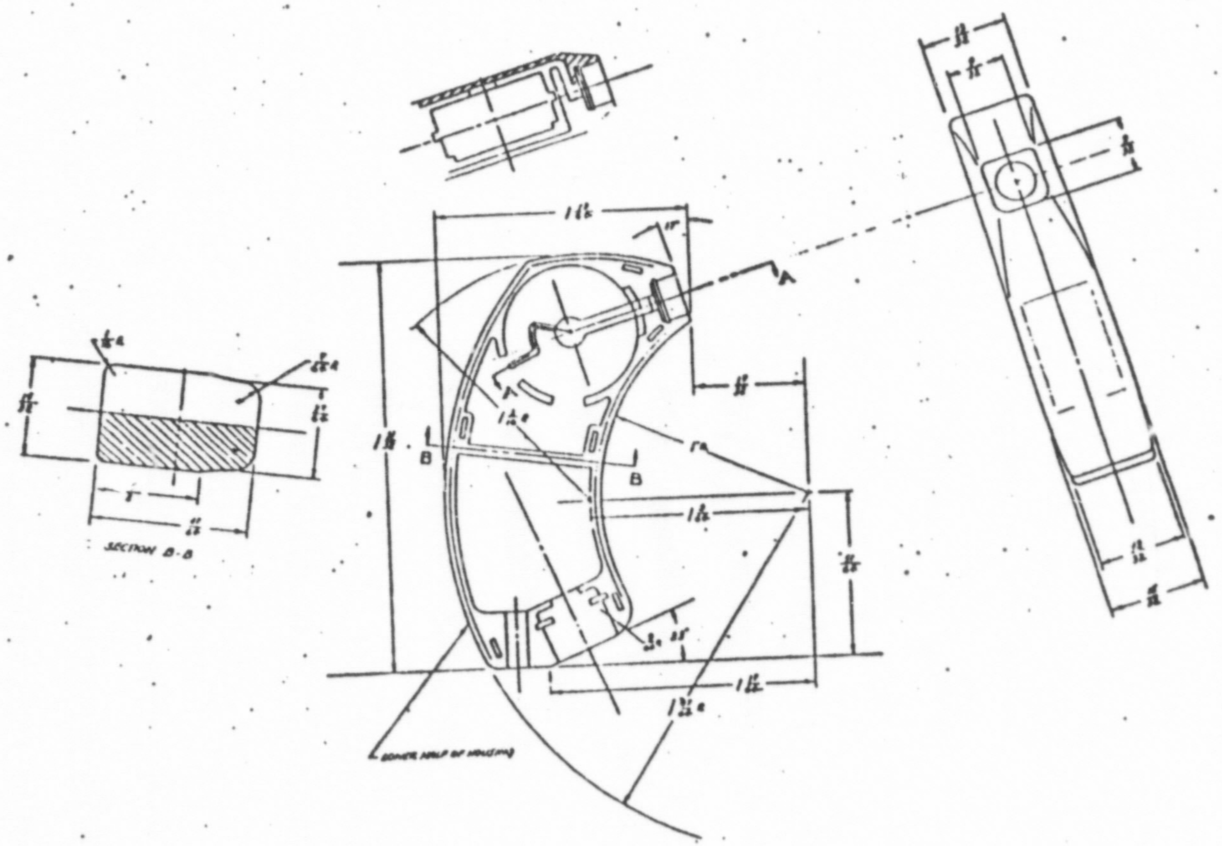


58

F 0651



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JUL X X 1972

581

61

CROSS SECTION DOCS

62.

Roanwell CORPORATION

ROANWELL BUILDING · 180 VARICK STREET · NEW YORK, N.Y. 10014
YUkon 9-1000 · TELETYPE: 212 640-4791

Sept. 26, 1969

Mr. James O. Woodbridge
Executive Vice President
Unex Laboratories, Inc.
Hathorne, Mass. 01937

Dear Mr. Woodbridge:

The following terms and conditions shall apply to the purchase order which we are planning to place with you for development work.

Please signify your agreement by signing and returning a copy of this memo to me.

1. All information disclosed by Roanwell in the performance of the outlined task is confidential. All drawings done in the performance of the task shall be marked "Confidential, shall not be disclosed to anyone outside of Roanwell and Unex".

2. All drawings, tooling, fixtures shall become the property of Roanwell Corporation and surrendered upon demand.

3. All patentable ideas resulting from this development shall become property of Roanwell Corporation.

4. Unex shall not sell the end product (as described in the attached Design Objectives dated Sept. 26) or a similar product to anyone but Roanwell Corporation.

5. Unex shall not use this development or the Roanwell relationship for advertising or promotional purposes unless specificall[y] authorized in writing.

(continued)

F 0656

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582

CROSS SECTION DOCS

Unex Laboratories Inc. Sept. 26, 1969 63-
Hathorn, Mass. page 2.

6. As soon as the job which is to be performed is disclosed to Unex, if any conflict arises on proprietary information Unex shall inform Roanwell within a few days.

7. The job shall be performed on a fixed rate basis for a 6 month period. The rates shall be:

Tool & Die Maker	$10.00	per hr.
Technician	$10.00	per hr.*
Assembly & Plastic Molding	$ 6.50	per hr.
Drafting	$ 8.00	per hr.
Project Engineer	$15.00	per hr.**

* Includes equipment already available at Unex.
** This rate assumes that the project engineer performs a combination of engineering and design drafting on approximately 50% - 50% basis.

8. Mr. Nichols or alternate approved by Roanwell, shall be the project engineer on this project and shall be available on a minimum 20 hr. per week basis.

9. Brief and written bi-weekly progress reports shall be made to report status and obtain approval of billing.

10. Partial payments shall be made monthly at 75% of the billed amount and the 25% balance shall be paid upon completion of the project or every three months, whichever is sooner.

11. All direct expenses such as travel, telephone, etc. shall be billed on a cost basis. Any one expenditure exceeding $100 shall be approved by Roanwell prior to commitment.

12. All technical contacts shall be through the undersigned. All other contacts shall be with Mr. Dave DeParis.

Very truly yours,

ROANWELL CORPORATION

Hans C. Mol

Hans C. Mol
Vice President of Engineering

HCM/gw

James O. Woodbridge, Exec. V.P. 9/26/69

AGREED: James O. Woodbridge Date

F0657
P.O. 23493
002507
583

64

Attachment to letter dated Sept. 26, 1969
to James O. Woodbridge,
Unex Laboratories, Inc.

70 SERIES HEADSET

DESIGN OBJECTIVES

1. The hoped for end objective is to build a headset which can be used by a PBX operator, without requiring earmolds or any other device unique to the particular operator. The headset shall be usable by either male or female of normal size, (90% of population), either on the right or left side of head. The headsets shall be attached without use of headband, eyeglasses, etc.

2. The headset shall use the transducers supplied by Roanwell and should if at all possible use the vibration isolation boots which are already being used by the transducers.

3. If at all possible, the headset shall use as many parts as possible from the existing headset such as speech tube, ball socket, cord assembly, but not if there is a serious performance compromise.

4. The amplifier will not be part of the design task, and shall not be part of the headset.

5. The output from the headset shall be per the attached spec, which is the approved spec for telephone use.

6. The cord assembly and the transducer shall be easily replaceable preferably without soldering or use of special tools.

F065

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584

OVER EAR IN JT TUBES

78

65

ROANWELL CORPORATION

HANS. C. MOL

CONFIDENTIAL

F0659

002495

585

HATHORNE, MASSACHUSETTS 01937 / (DANVERS) / (617) 774-[illegible]

ROANWELL CORP.

70 SERIES HEADSET PROJECT

Initial Report - First Week - Sept 26 to October 3rd.

BACKGROUND: - As a result of meeting held on Friday, Sept 26th between Mr. Woodbridge and Mr. Nichols of Unex, and Mr. Powers, Mr. Potter, Mr. Mol, Mr. DeParis, Mr. Morrison, and Mr. Kloek, general working agreements and design objectives were set for developing a new head set.

INITIAL STUDY: -A review of Roanwell's objectives, related designs, assorted models and parts, and drawings was made to study the problems envolved. The initial Roanwell #2 and #3 layouts for a 70 Series headset provided good starting designs, lacking only details and minor refinements for a possible end product.

STUDY OF ALTERNATIVES:- Several design possibilities were rough sketched with brief Pro and Cpn comments, as were various possible ear locations, disconnect and wire termination considerations (See sketches #1,2,3,6,7).

BEST INITIAL SELECTIONS: - Two alternate designs were rough sketched in some detail (See #4 and #5), and rough wooden models made to show the approximate size and wearing possibilities. An attempt was made to incorporate and list some new features not in the origiønal #2 and #3 designs as variations for possible consideration.

NEXT STEP: - Based on our joint evaluations of the various design features to date, more detailed drawings, models, or performance tests can now be scheduled on the more promising ideas.

REFERENCE DATA: - Three Knowles Electronics technical bulletins are loaned with this report as general information on the effects of tubing length, size, etc on transducer performance.

N. P. Nichols
10/3/69

V F0660

586 002496

67

POSITIONING:

PRO

CON

(1) IN THE EAR

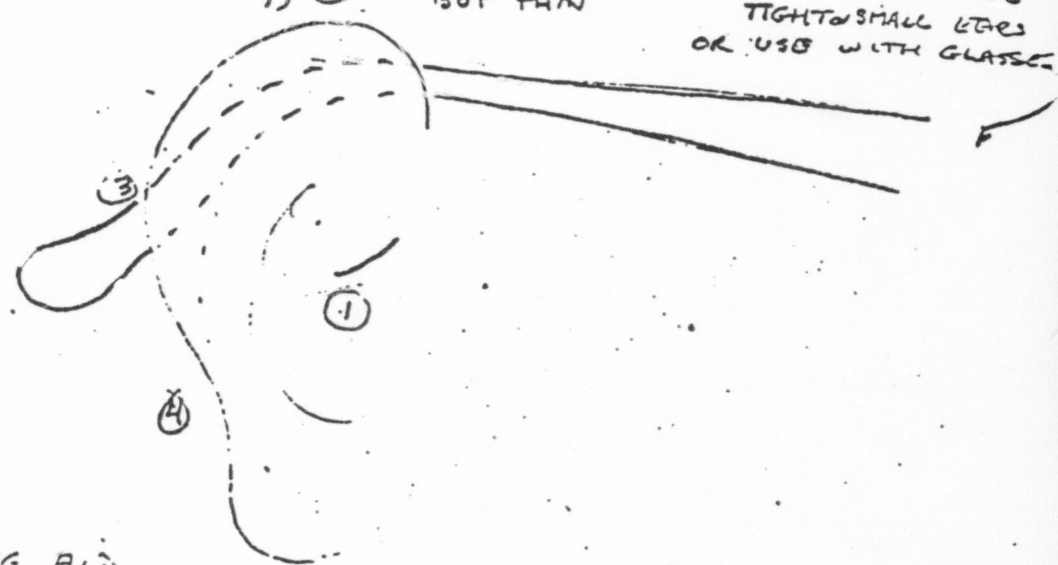
MAX OUTPUT
CLEAR OF GLASSES

RT + LT PROBLEM
APPEARANCE POOR
INSECURE

(2) TOP OF EAR

(2) MAX EAR FLAP
BUT THIN

TOO THIN FOR
TIGHT & SMALL EARS
OR USE WITH GLASSES



(3) HEARING AID
BEHIND EAR STYLE

(5) SECURE,
CONCEALED, BUT

SOME TROUBLE
WITH GLASSES
AND SMALL TIGHT
WOMEN'S EAR

(4) LOW SLUNG

GOOD COMFORT
" APPEARANCE
" TUBE POSITIONING
NO GLASSES PROBLEMS
SECURE
ANY CASE THICKNESS
SHORTER INPUT TUBE

EAR HOOK SIZING
GLASSES ...
OUTPUT TUBE =
LOWER RESPONSE
FREQUENCY.

(5) UNDER SLUNG

GOOD COMFORT FOR
ANY CASE THICKNESS

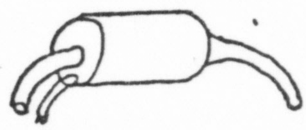
POORER APPEARANCE
LESS STABLE &
SECURE

F0661
002497
587

UNEV LABS

Alternative Designs

(A) Simple Cartridge Types

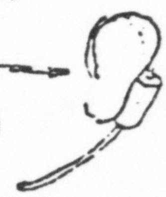


PRO - CON

OVER EAR — (TOO FAT)

BACK OF EAR " "

LOW BEHIND (OK) →



UNDER (INSECURE)

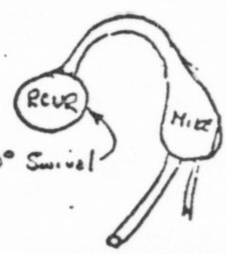
(B) Behind the Ear
Hearing Aid Type

ROUND SECTION (OK, if be like above)

FLAT SECTION (OK, if thin enough for small women's ears)

(Interfers with glasses if worn high)

(C) Divided Types



Needs 180° Swivel

(RIGHT + LEFT PROBLEM)
IF ONE SOLID HOUSING

(TOO BULKY)

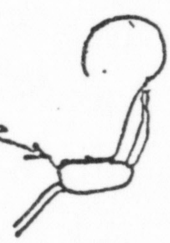
(D) Hanging Types

(NOT SECURE)

IN THE EAR

(INSECURE)

UNDER



BEHIND

(BETTER)

COMMENT A + B seem best

SKETCH — 3

69

Design Problems:

1) Best location on Ear
2) Best size + shape with existing parts
3) Best wearing comfort + security
4) Position cavity seals
5) Easy disconnect + service, all parts.
6) Easy production assembly
7) Easy low cost tooling + parts
8) Swivel vs formable input tube
9) Type of ear tip for good seal, all sizes
10) Adjustments for all ears - easy fitting
11) Max dependability + Shock resistance
12) Feedback elimination, mountings, leaks magnetic coupling, reflection, etc
13) General use appeal
14) Case closing means

F0663

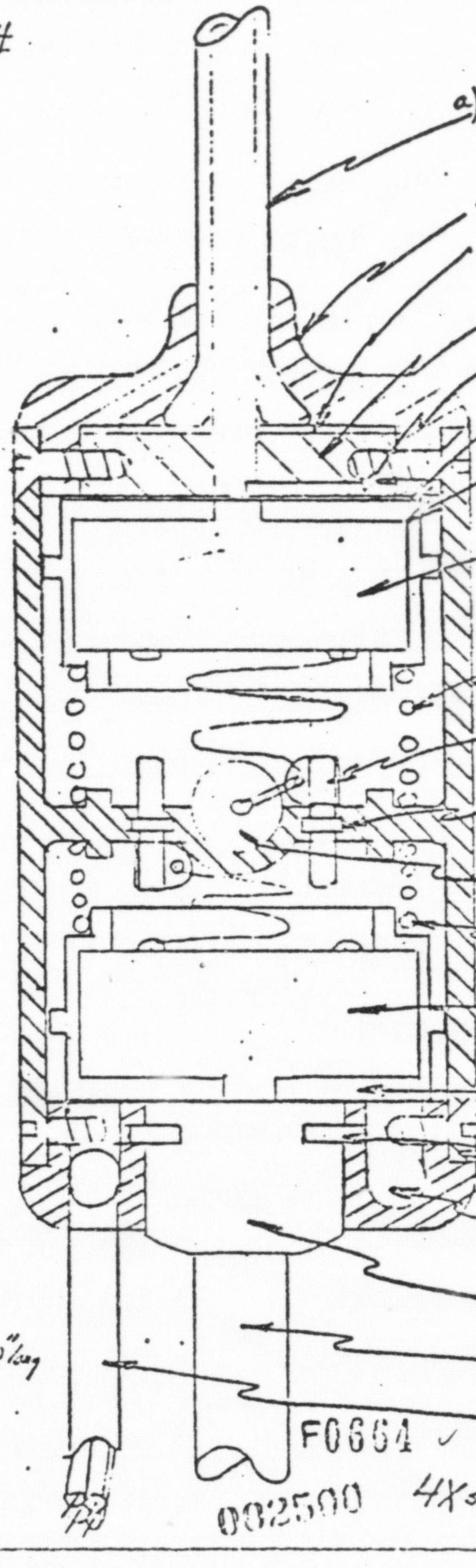
002499 589

LAYOUT No 40

SIMPLE CARTRIDGE FORM
FOR POSITION #4

Features

1) Simple tooling —
2) Easy service —
3) Positive seal, input to output —
4) Using existing:
   Boots
   Tubes
   Springs
   Transmitter
   Receiver
   Varistor
   Screen
   etc
5) Non-Hearing Aid Shape —
6) OK for Position # 4 fit, any size ear or head —
7) Functional appearance —
8) New Parts:
   Plastic - 4 pcs
   Terminal posts - 4/unit
   " clips - 4/unit
9) Size - approx —
   .700" Diam by 1.320" long



PARTS:

a) Output Tube, replaceable
b) Top Cap
b') Gasket seal
c) Tube retainer with
d) - controlled leak path
d') Screen #19101
e) Boot # 19102
f) Receiver # 114070
g) Spring # 19106
h) Clip (4)
i) Post, molded thru (4), for zero sound leaks
j) Varistor, 19125
k) Spring # 19106
l) Transmitter # 114020
m) Boot # 19102
n) Retainer # 19104
o) Cord groove - strain relief
p) Ball assembly # 69320
q) Tube # 19118, etc
r) Cord

590

UNEX LABS
Hawthorne, Mass

4X size

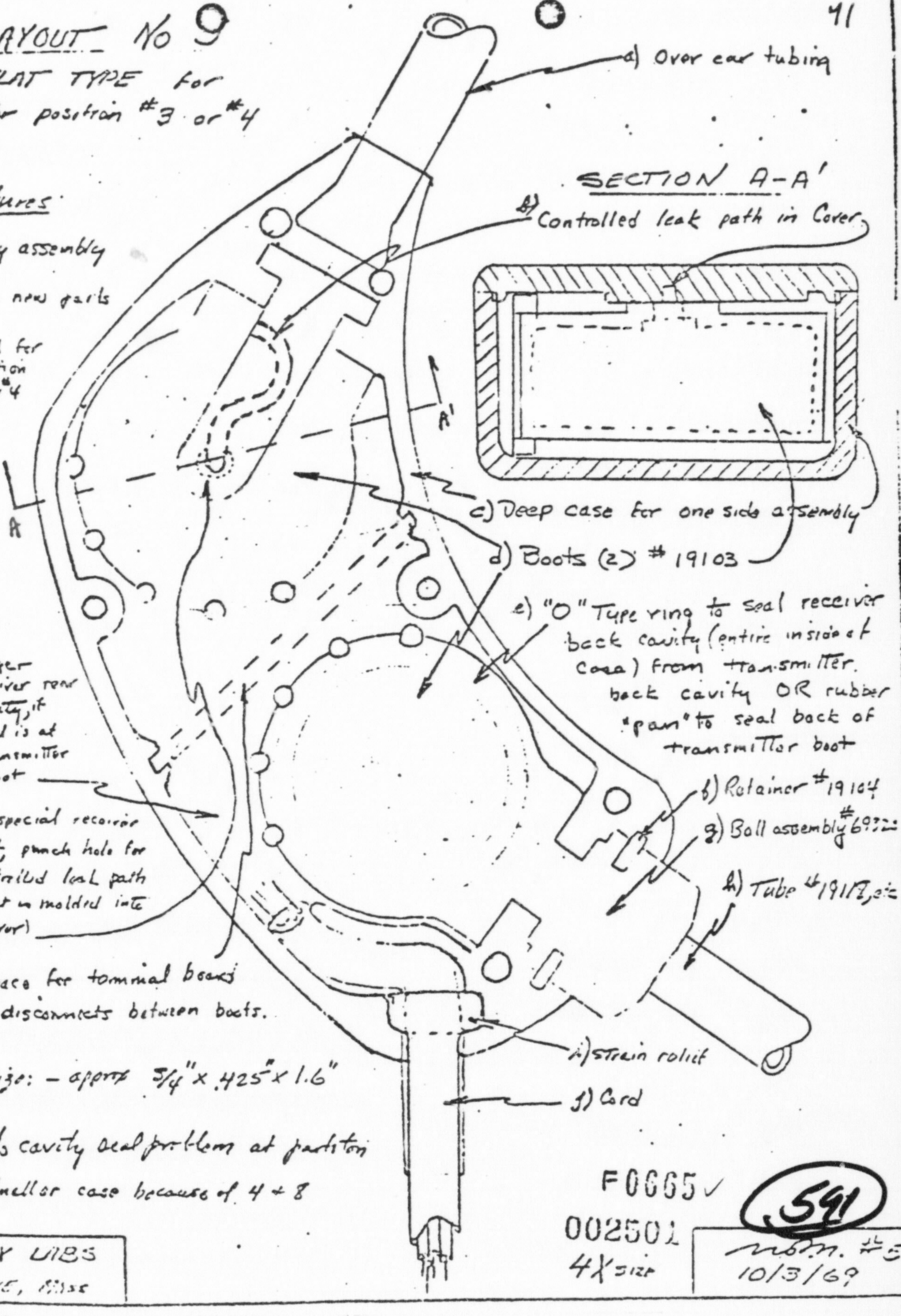
NGH 0/2/69
Sketch No. 4

Cartridge 7 pp

LAYOUT No 9
FLAT TYPE for
for position #3 or #4

Features

1) Easy assembly
2) Few new parts
3) Good for position #3 or #4
4) Larger receiver rear cavity, if seal is at transmitter boot
5) No special receiver boot, punch hole for controlled leak path (that is molded into cover)
6) Space for terminal boards & disconnects between boots.
7) Size: - approx 3/4" x .425" x 1.6"
8) No cavity seal problems at partition
9) Smaller case because of 4 + 8



F0665 ✓
002501
4X size

591

UNEX LABS
, Mass

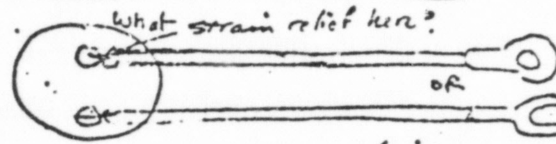
MOM #5
10/3/69

Question - Method desired for

TRANSDUCER DISCONNECT ?

(A) Soldered lead with screw on lugs

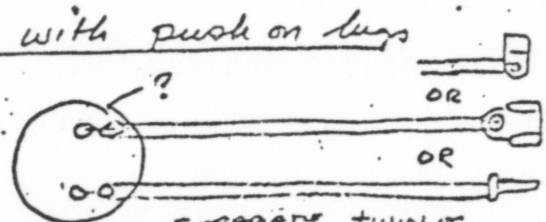
what strain relief here?

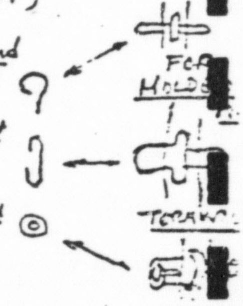


TYPE ?

(Size a problem)

(B) Soldered lead with push on lugs



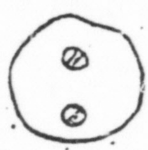


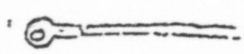
SEPARATE, twin or twisted? Size & type ?

(C) SCREWS ON TRANSDUCERS ?

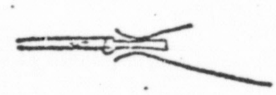
LUGS ON WIRE leads + cable ?

Can this be done?

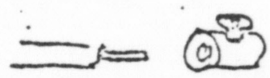




(D) SPRING CONTACTS



(E) SCREW ON TERMINAL



(F) OTHER

F0666 / 592

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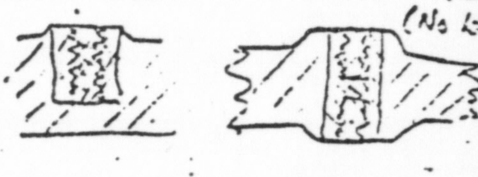
[illegible]

[illegible]

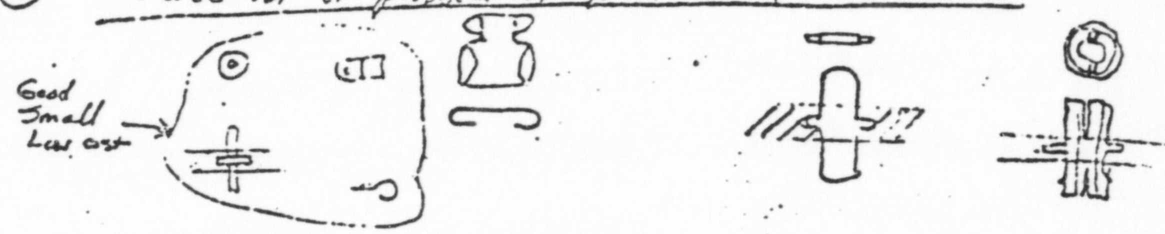
TERMINAL STYLES ?

(A) Molded in or pressed in screw bushings

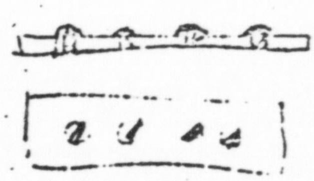
ONCE SIDE THRU TYPE (No ...



(B) Molded in or pressed in pin or flat contacts

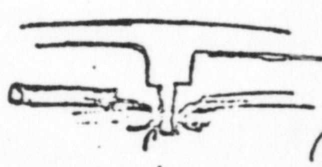


(C) Sub strip, with terminals
(various shapes + terminal types possible)



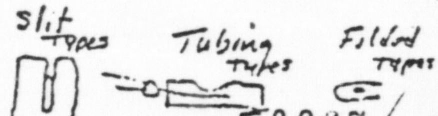
(D) Solder-in wires (assumed undesirable)

(E) Welded in contacts,
eyelet + wedge, etc



(too big + uncertain

(F) CRIMPED CONNECTIONS
(assumed poor)



(G) WELDED (assumed ...)

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74

ROANWELL CORPORATION

70 Series Headset Project

Second Report for period October 6, 1969 to October 21, 1969:

Mr. Woodbridge brought the initial weeks report, drawing and models to New York on Monday October 6, for general discussions. During the second week I largely marked time pending receipt of component parts, and your evaluation of our initial thoughts. However a few hours were spent on further details on the original sketches to check feasibility and clarify design possibilities.

In response to your initial reaction to our first report, I did additional general design and sketches on the possibilities of an over the ear voice tube as suggested by your sales department, more detailed layouts for the flat hearing aid type with one possible terminal construction, additional terminal and strain details for the cylindrical type, and additional wearing and fitting considerations and models.

It is expected at a meeting on Wednesday, October 22nd, we can zero in on best design considerations and proceed on more detailed drawings, initial breadboard testing, or more complete models for evaluation. A survey of operator reactions to various models should probably be done before too much detail drawing is attempted.

N. P. Nichols
10/21/69

F 0681

002491

JUL X

HATHORNE, MASSACHUSETTS 01937 / (DANVERS) / (617) 774-3000

594

SKETCH 4
75

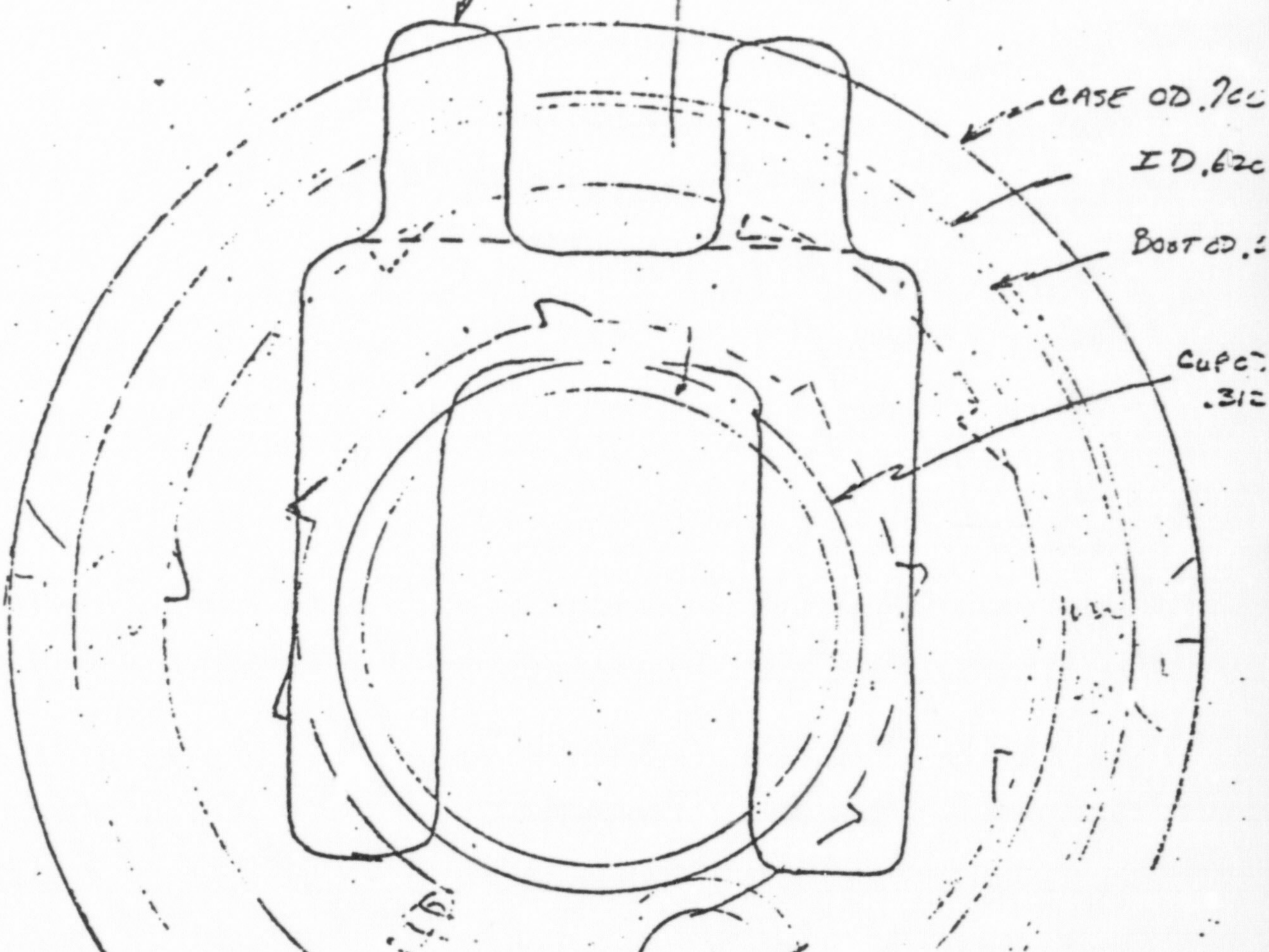
(069310)
SPEECH TUBE ASSEMBLY

CORD STRAIN RELIEF

HELD BY MODIFIED

RETAINER # 19104

Questions:
a) Cable size + Type
b) 3 or 4 leads



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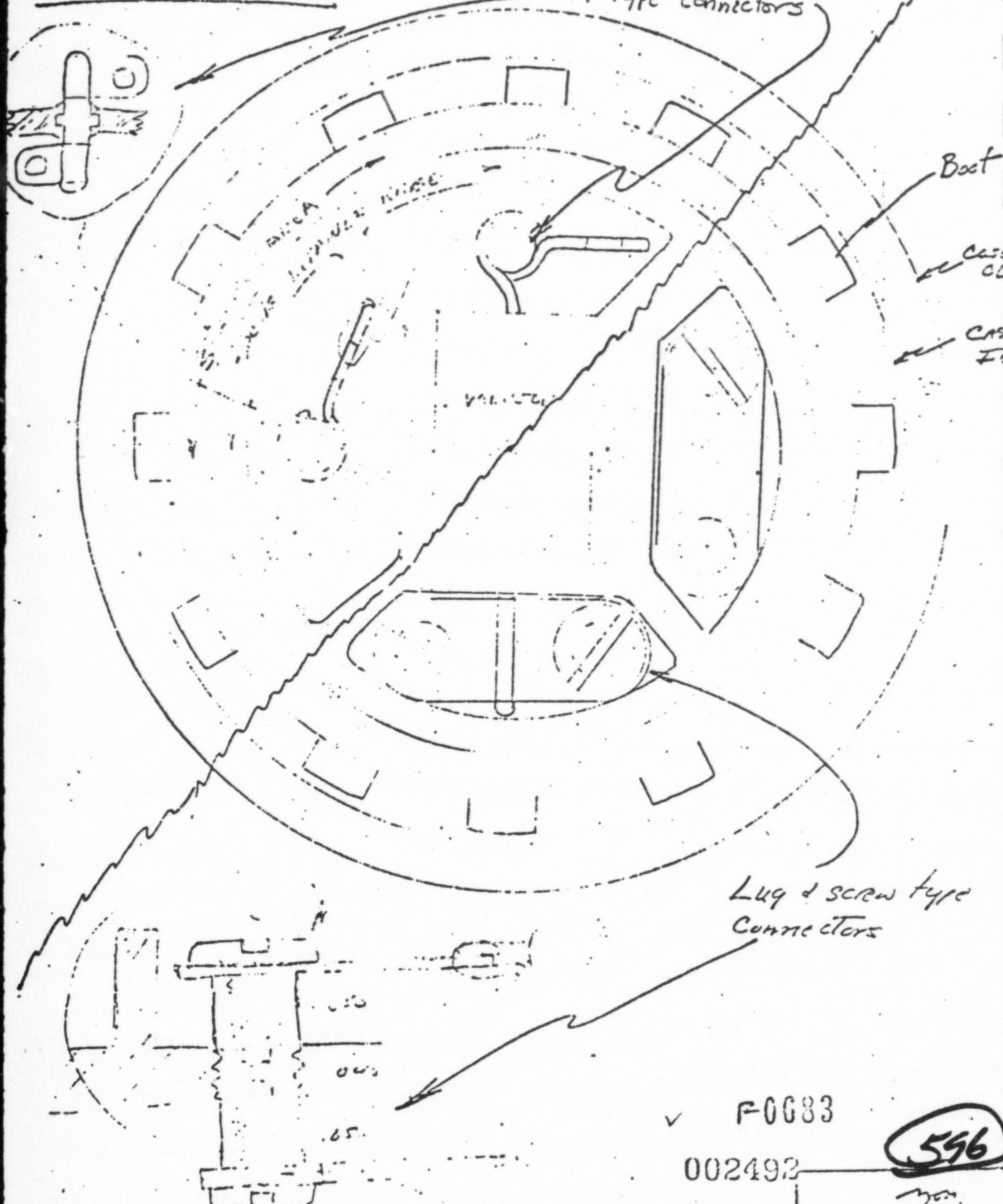
545

CROSS SECTION DE[illegible]ICS
at PARTITION + TERMINALS



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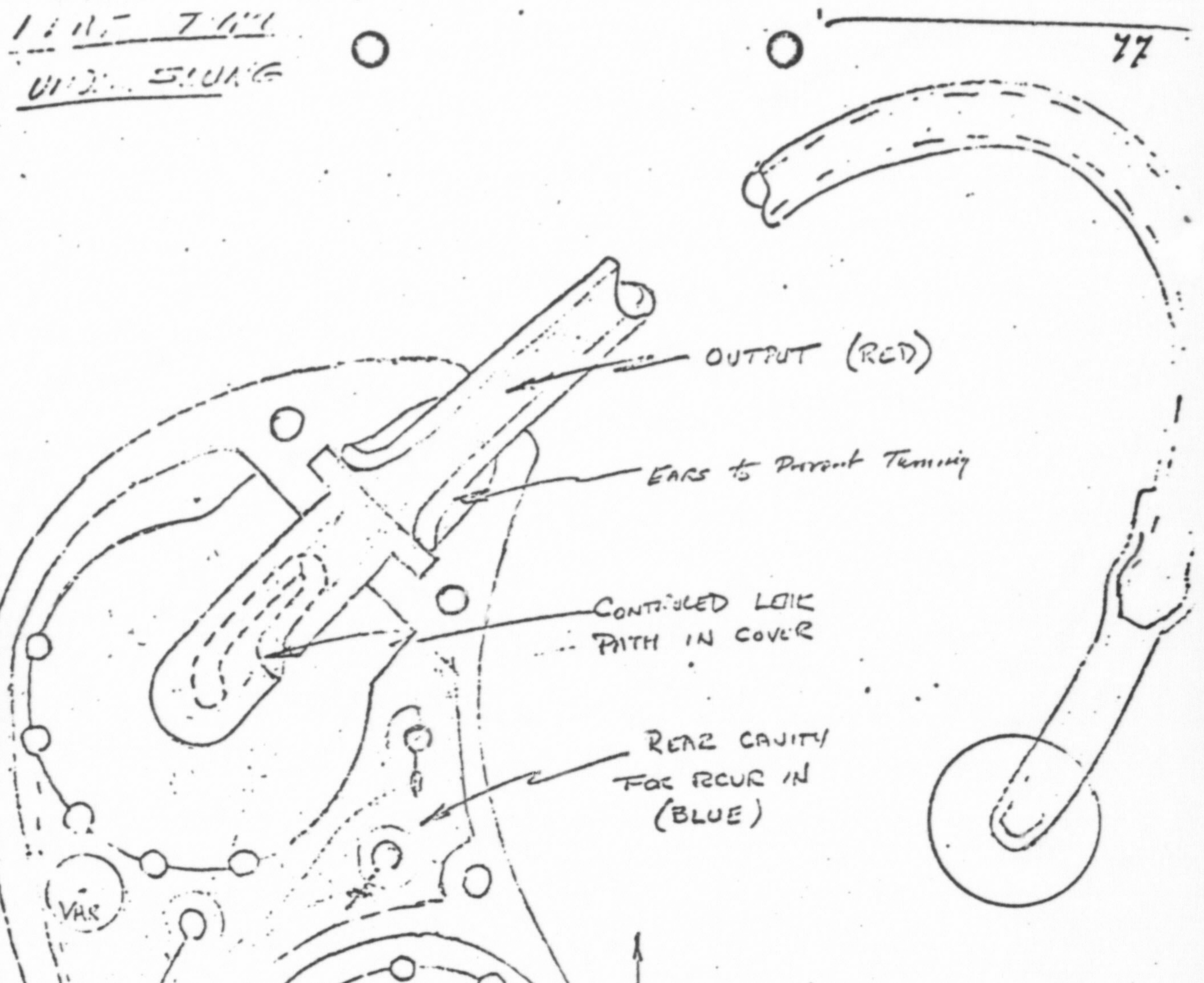
556



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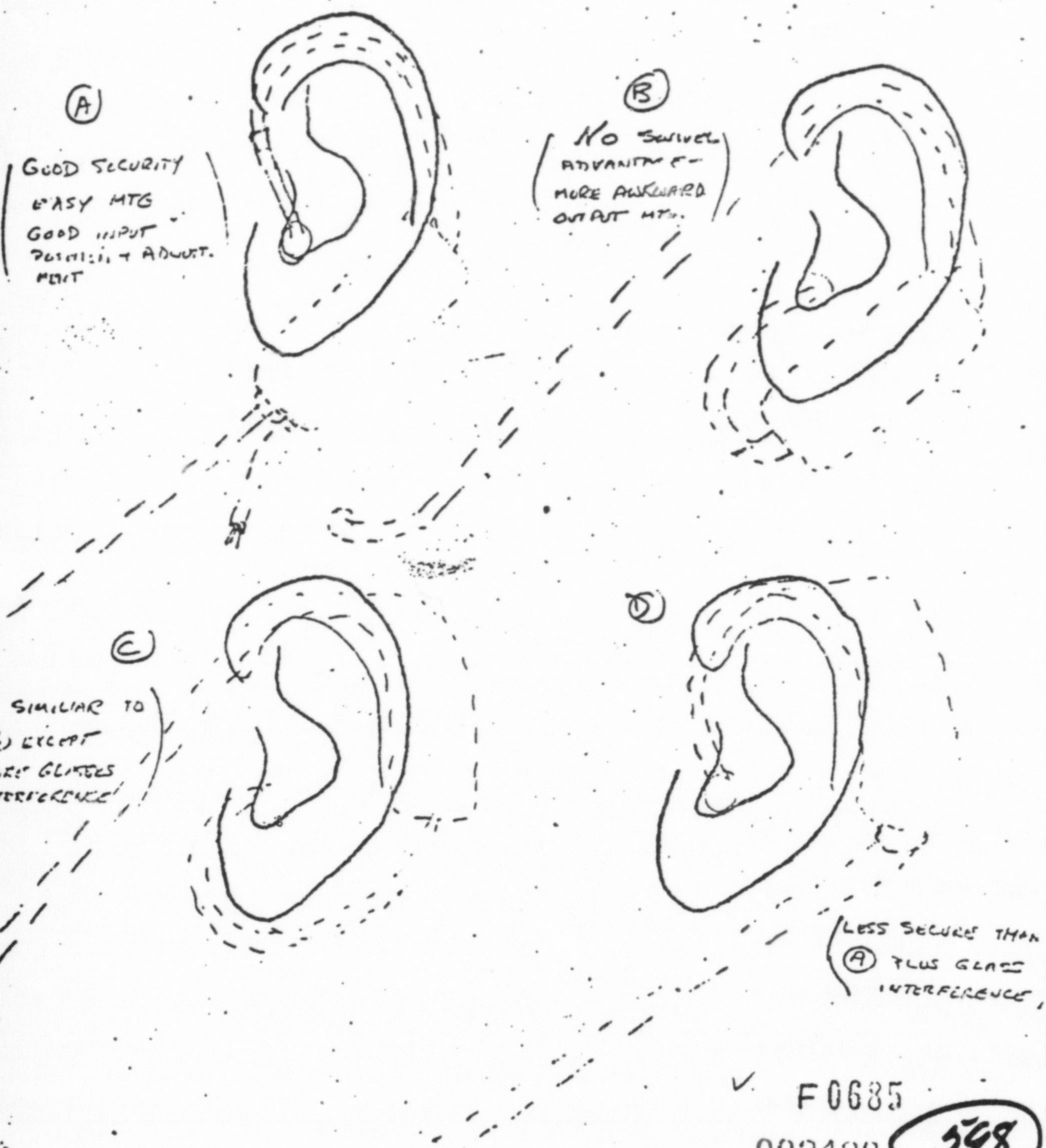
OVER EAR INPUT TUBES vs. OVER EAR OUTPUT TUBES

& HIGH VS LOW UNIT MOUNTING



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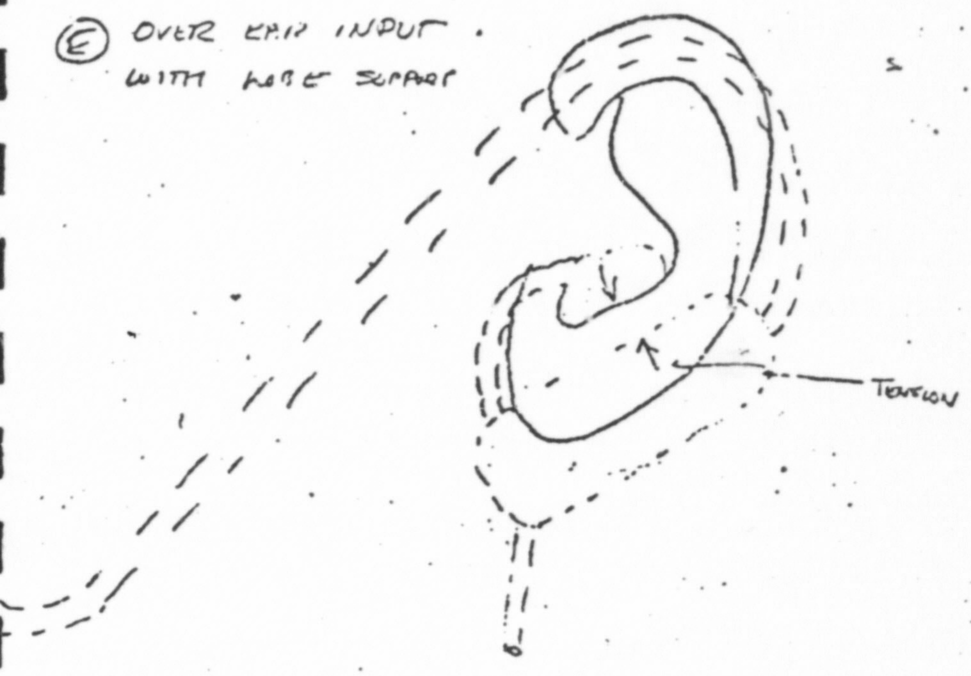
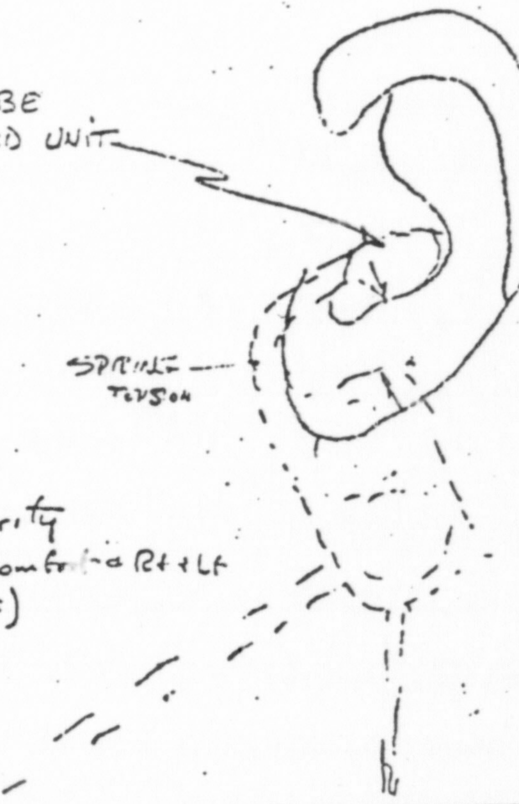
8/14/67

(E) OVER EAR INPUT.
WITH LOBE SUPPORT



(FAIR, but fitting + Rt + Lt problems)

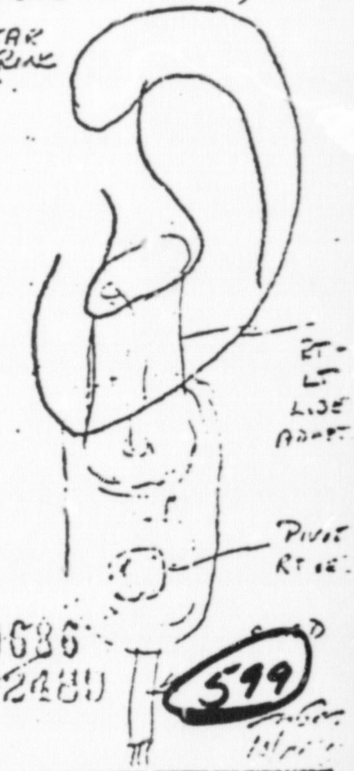
(F) EAR LOBE
SUPPORTED UNIT



(Poor Security
Fitting + Comfort + Rt + Lt
Problems)

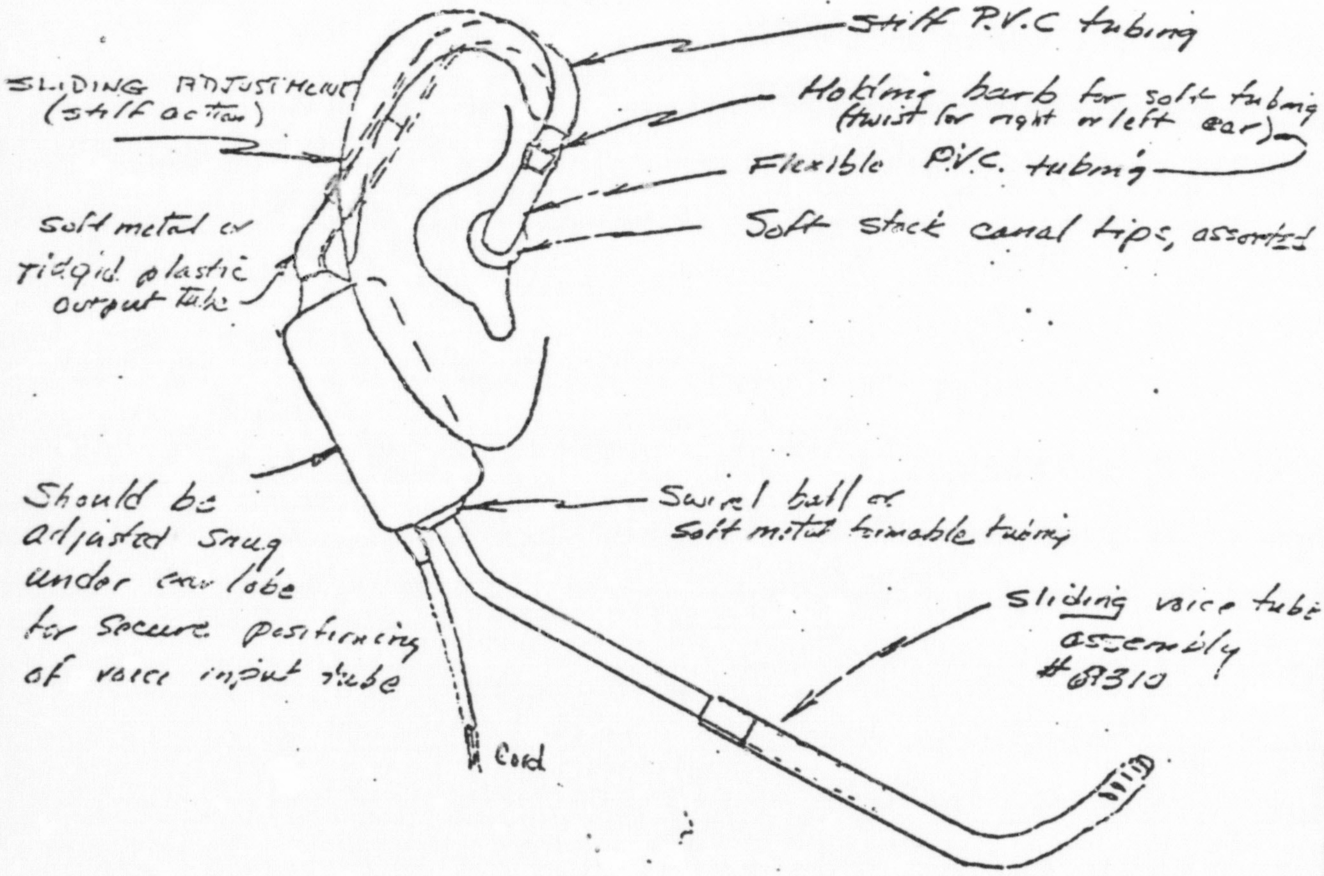
or

(G) LOBE HANGING, LIKE
EAR RING



(POOR)

Adjustable Wearing Setup
for Cartridge Type Unit
in #4 Low slung position



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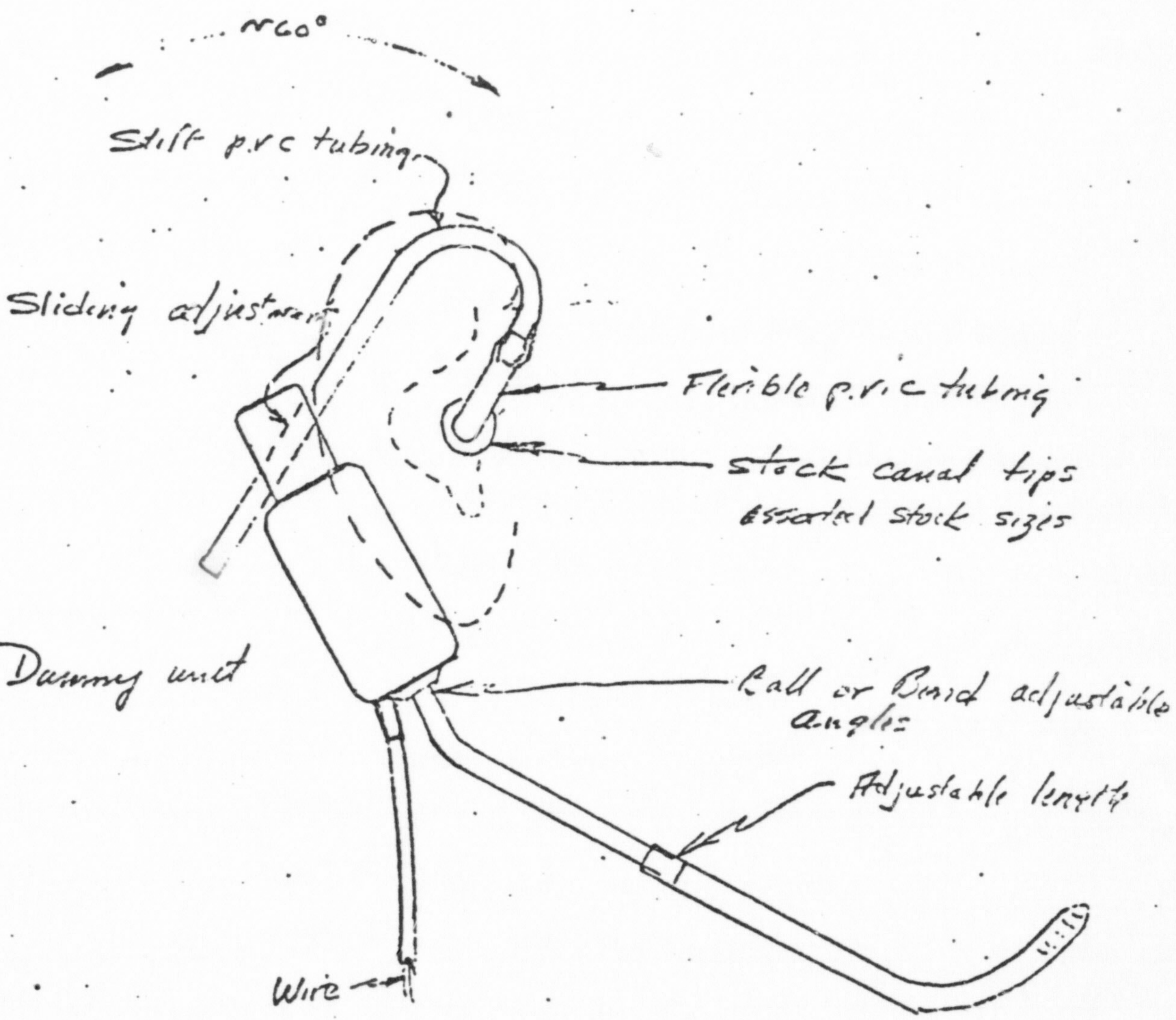
10/15/68

Dummy Fitting Unit
for Cartridge Type Units
in # 4 Low slung position

81



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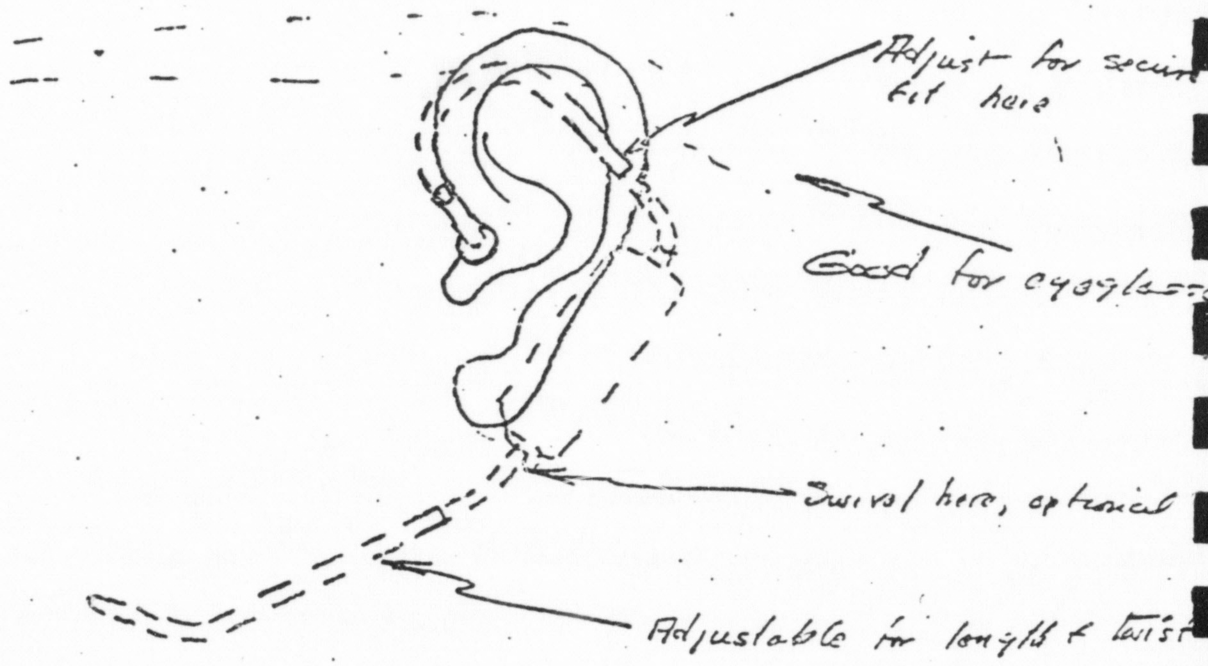
10/16/

Sketch # 16

82

Cartridge Type — Low Position



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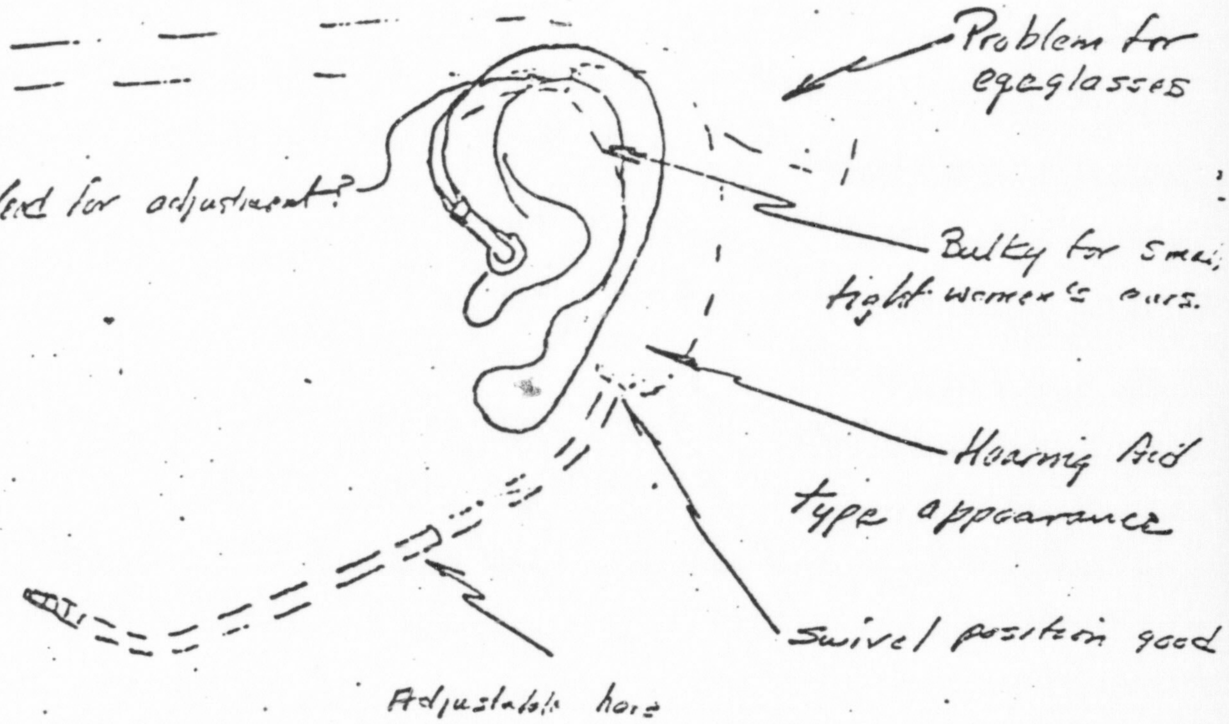
12-9.

Flat Type ⓞ High Position



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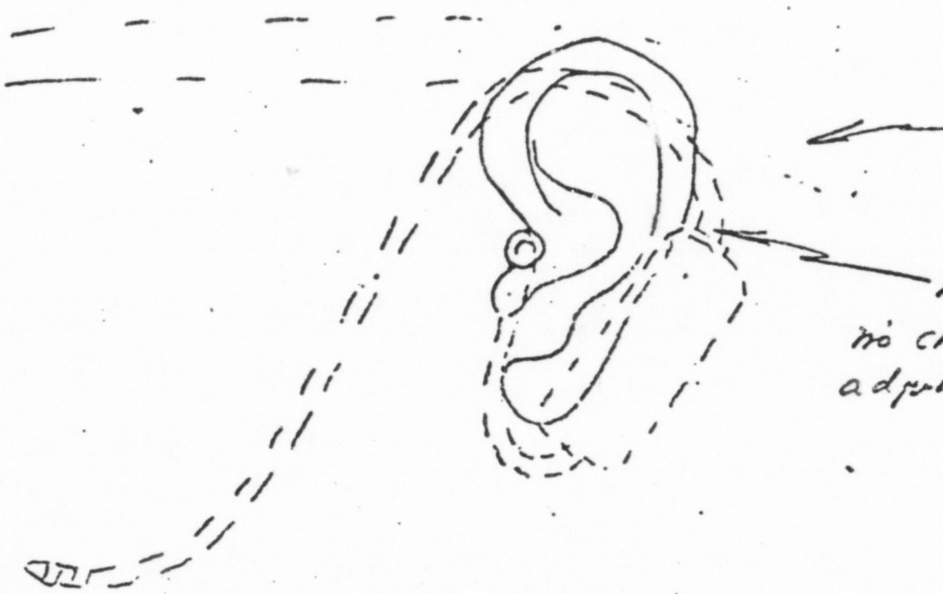
Cartridge 7 pp

Over the Ear Voice Input

Under Ear Output



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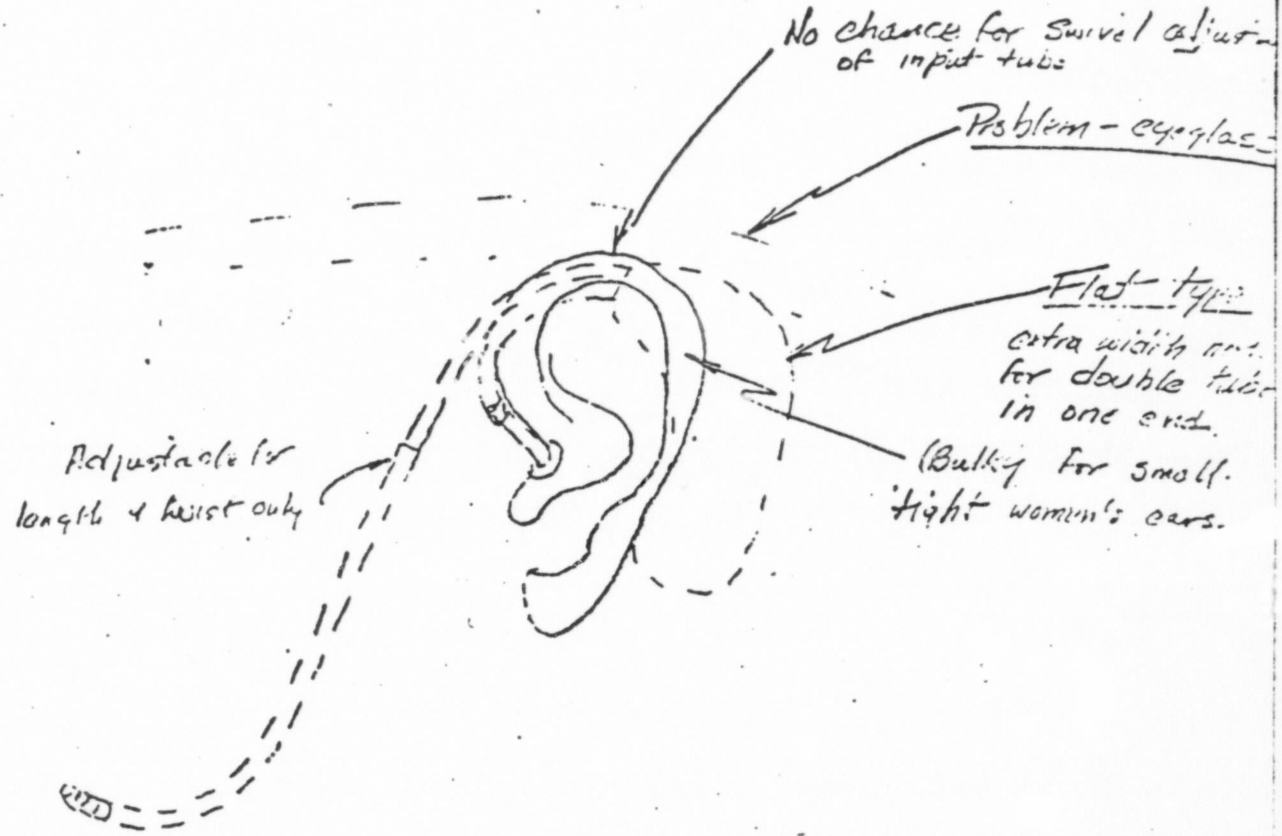
Over Ear Voice Input

Over Ear Output



(See Wooden Model)

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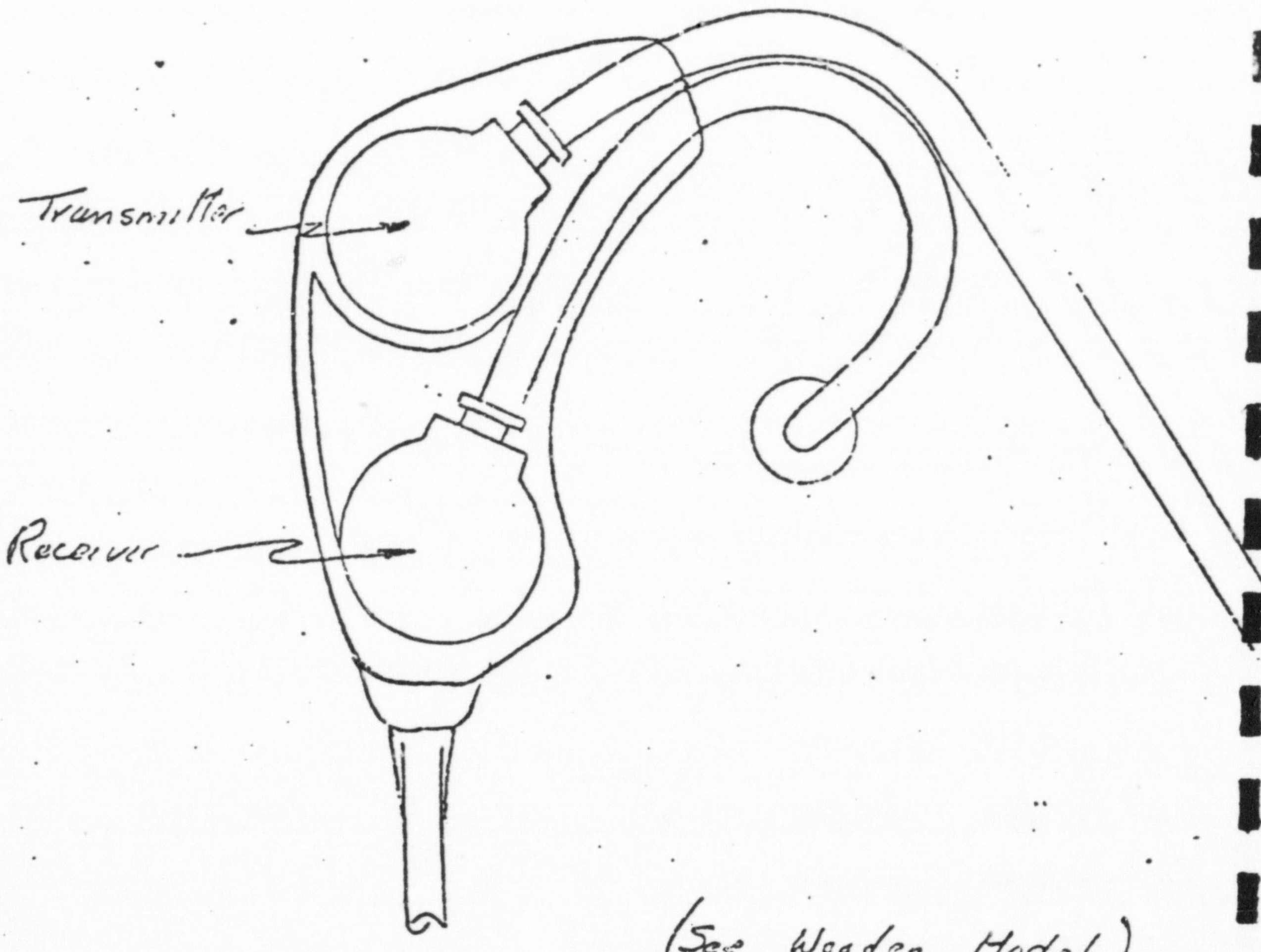
Flat Type Over Ear Voice Tube

Basic Layout only



(See Wooden Model)

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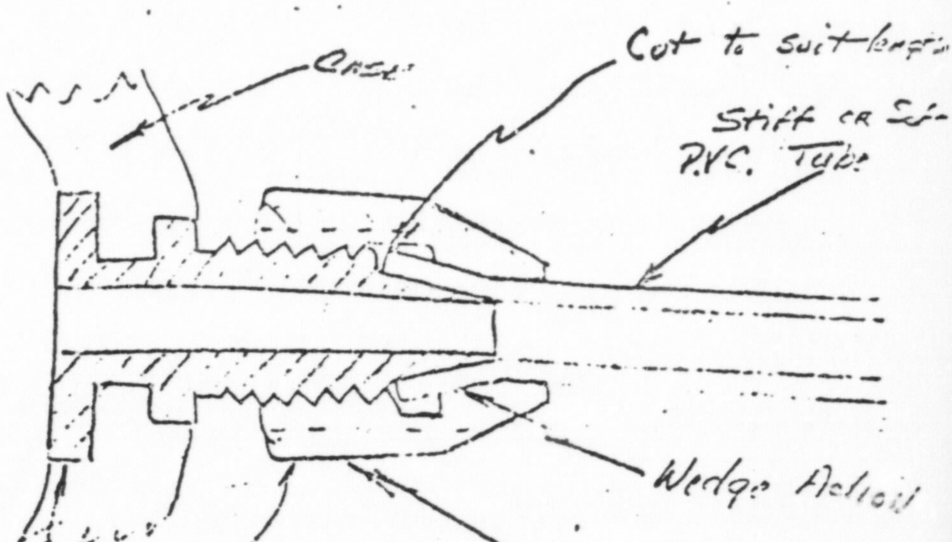
n2x

Output Pipe Connecter

(A) For PLASTIC TUBING

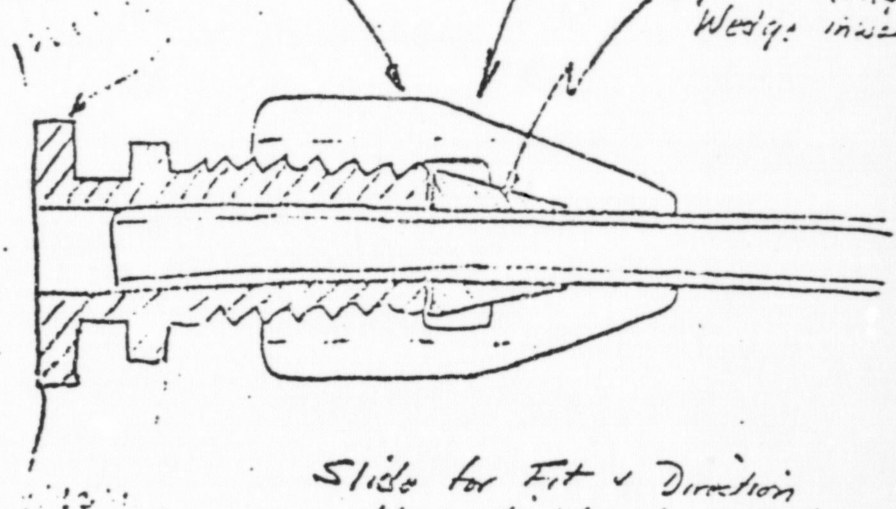


Hex Stock

Hex Clamp Nut

(B) For Metal Tubing

split Ring Wedge insert



Slide for Fit & Direction then tighten hex Nut

Material – S.S. etc

V F 0694
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687
10/21/69

88

ROANWELL CORPORATION

Series 70 Development

Report for Period October 22, 1969 through November 7, 1969

At our meeting in New York on October 22nd, it was decided that adjustable means were necessary to fit all types and sizes of ears, and that an under the ear lobe hook was needed for good stability with all types of units.

During the following week various type of hooks were tried and six dummy models were prepared for running, preference and fit tests on both male and female ears. The result of limited local tests were tabulated and at a visit here by Mr. Mol, on October 30, it was decided to narrow the models down to two types and proceed with working models of each. One model to be similar to the P. P. I. design with over-the-ear input pipe, but with Roanwell transducers, and the other model to be the most acceptable flat type behind-the-ear unit with over-the-ear output.

We also decided to add a plug-in cord, as featured by P. P. I. Therefore, new details and drawings were made for a first model of each configuration and model case, boot, swivel and other parts started for getting a first working model of the newest flat type. Hopefully, this will be ready during the week of November 17, to be followed by the P. P. I. type as soon as the necessary new parts can be made.

A drawing of the layout for the first working model is enclosed, as well as an accounting of engineering and travel time spent to date.

M. G. Nichols
11/7/69

F0055

002480

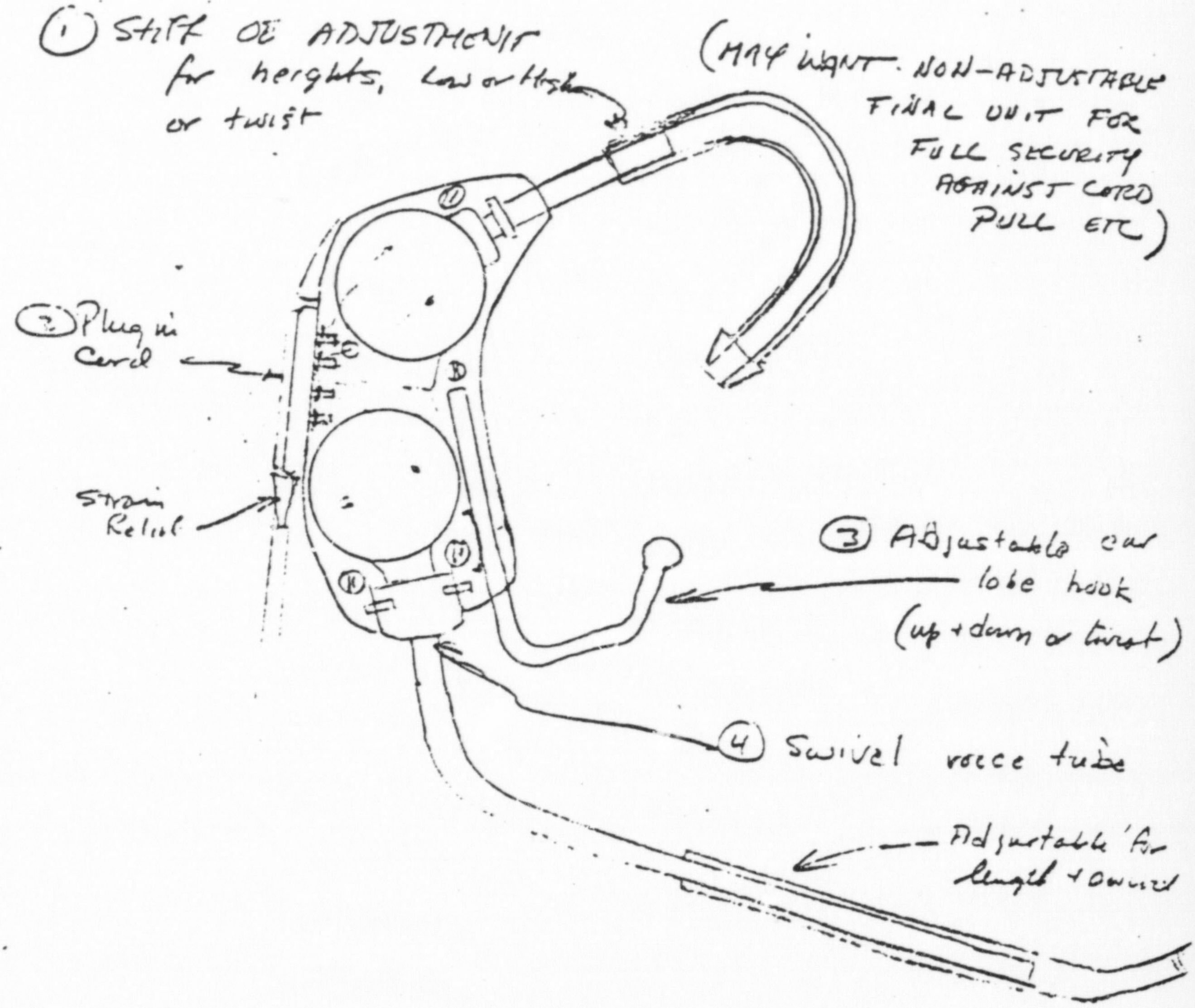
Replace in F papers file

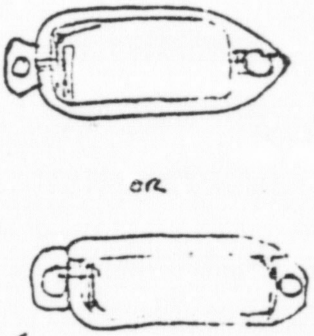
JUL

HATHORNE, MASSACHUSETTS 01937 / (DANVERS) / (617) 774-3300

608

Flat Model for
High or Low Mtg. Tests





made rough model of 3,
10/7/[illegible]

F0696
002479
609
10/24/[illegible]

Mate Preferences (only 3 samples / data) 10/30/91 at UNEK 90

Eye appeal

1	3 - 6 - 6	15
2	1 - 5 - 5	11
3	2 - 4 - 4	10
4	4 - 2 - 3	9
5	5 - 3 - 1	9
6	6 - 1 - 2	9

Wearing Comfort

1	6 - 5 - 4	15
2	5 - 4 - 5	14
3	1 - 6 - 6	13
4	4 - 1 - 3	8
5	2 - 3 - 2	7
6	3 - 1 - 1	5

Security

1	6 - 6 - 6	18
2	5 - 4 - 5	14
3	4 - 5 - 4	13
4	3 - 3 - 3	9
5	1 - 1 - 2	14
6	2 2 - 1	5

F0697

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Wearing Comfort

PREFERENCE TEST

70 Series Initial Samples - Confidential Report

# Type of Unit	SCORES ~~Eye Appeal~~	Wearing Comfort	TOTAL ~~Security~~	CHOICE
1) P.P.I., top input	6-6-2	-5-5-1-6-6-6	43	6th
2) Flat, top input	5-2-6	-6-4-4-5-5-3	40	5th
3) Flat, high mount	4-1-5	-2-3-3-4-4-5	31	4th
4) Flat, low mount	1-3-1	-1-6-2-3-3-1	21	1st
5) Round, low mount	3-4-3	-3-1-6-1-2	26	3rd
6) Oval, low mount	2-5-4	-2-2-5-2-1-2	25	2nd

Initialed by 9 Sex F

Date 10/20/69 at UNCX

F 0658

00247?

611

1) Female Preferences

Eye Appeal

PREFERENCE TEST

70 Series Initial Samples - Confidential Report

#	Type of Unit	Scores Eye Appeal	Total ~~Wearing Comfort~~	Choice ~~Security~~
1)	P.P.I., top input 2	6-1-6-2-2-4-6 5	/ ~~54~~ / $\boxed{34}$	3rd
2)	Flat, top input 4	5-2-5-5-1-2-5-6	/ ~~31~~ / $\boxed{35}$	4th
3)	Flat, high mount 3	2-3-2-3-3-3-4-2	/ ~~22~~ / $\boxed{[illegible]}$	2nd
4)	Flat, low mount 1	-1-4-1-1-4-1-3-1	/ 16 / $\boxed{17}$	1st Choice
5)	Round, low mount 5	4-6-4-6-5-6-1-4	/ ~~36~~ / $\boxed{41}$	6th
6)	Oval, low mount 6	3-5-3-4-6-5-2-3	/ 31 / $\boxed{37}$	5th tie

Initialed by 9 Sex F

Date ______ at ______

F 0659
002476

612

(F) Security

93

PREFERENCE TEST

70 Series Initial Sampling - Confidential Report

# Type of Unit	Pre-Appeal	Housekeeping/Comfort	Security	
	SCORES		TOTAL	CHOICE
1) P.P.I., top input	6-6-6	-6-6-5-6-6-6	53	6th
2) Flat, top input	3-5-5	-3-4-6-2-5-2	35	5th
3) Flat, high mount	5-4-2	-2-3-4-3-4-1	28	4th
4) Flat, low mount	1-3-4	-1-5-1-1-1-3	20	1st
5) Round, low mount	3-2-1	-5-1-3-4-3-4	26 TIE	2nd
6) Oval, low mount	2-1-3	-4-2-2-5-2-5	26	2nd

Initialed by 9 Sex F

Date 10/20/67 at ULEX

F0700

0026[illegible]

613

UNEX
HEARING AIDS
SINCE 1938

Unex Laboratories

Sales 11-71

INVOICE 94

5717

70.

MANUFACTURER OF PRECISION BUILT HEARING INSTRUMENTS

A DIVISION OF

NICHOLS & CLARK, INC.

HATHORNE, MASS. 01937

TEL. DANVERS
774-3300

DATE November 18, 1969

SOLD TO
Att. Mr. Hans Mol
Roanwell Corp.
180 Varick St.
New York, N. Y. 10014

SHIP TO

DATE OF ORDER	CUSTOMER'S ORDER NO.	DATE SHIPPED	SHIPPED VIA	TERMS:
~~23493~~ 9/29/69	23493	11/18/69	FC-Spec.Del.	Memo

QUAN. ORDERED	QUAN. SHIPPED	DESCRIPTION	PRICE	AMOUNT
	1	Series 70 Headset First complete working model, with over ear output 0		Memo F0701 002473

WHEN PAYING INVOICE SHOW OUR INVOICE NUMBER

NOTICE: This material has been inspected, checked and carefully packed. Claims for shortages and defective material must be made within 5 days after receipt of goods. No credit will be allowed for goods returned without our permission.

JUL 1972

ORIGINAL

614

95

UNEX
HEARING AIDS
SINCE 1938

Unex Laboratories

MANUFACTURER OF PRECISION BUILT HEARING INSTRUMENTS
A DIVISION OF
NICHOLS & CLARK, INC.
HATHORNE, MASS. 01937

INVOICE
5759

TEL. DANVERS
617- 774-3300

DATE December 6,1969

SOLD TO:
Att:Mr.Hans Mol
Roanwell Corp.
180 Varick St.
New York, N. Y. 10014

20¢

SHIP TO:

DATE OF ORDER	CUSTOMER'S ORDER NO.	DATE SHIPPED	SHIPPED VIA	TERMS:
9/29/69	23493 Our#4018	12/06/69	Mr. H. Potter	Memo

QUAN. ORDERED	QUAN. SHIPPED	DESCRIPTION	PRICE	AMOUNT
	1	Series 70 Headset Second complete working model, with over ear input means second unit but first [illegible] #70		Memo F0706 002467

WHEN PAYING INVOICE SHOW OUR INVOICE NUMBER

NOTICE: This material has been inspected, checked and carefully packed. Claims for shortages and defective material must be made within 5 days after receipt of goods. No credit will be allowed for goods returned without our permission.

ORIGINAL

615

12-9. 96

UNEX File

ROANWELL CORPORATION

Series 70 Development

Report for Period November 24 to December 6.

This period was devoted to designing and building a second working model of Series 70 headset with an over the ear input similar to the P.P.I. configuration.

As in the first model, Roanwell transducers and boots were used, and a similar plug-in cord feature for easy disconnect. If the configuration and wearing comfort of this model is acceptable, and acoustic performance is reasonably right, further refinements of details and construction can now be made as a basis for initial production models.

N. P. Nichols
12/9/69

F 0707

002466

616

97

D. W. POWERS

R. W. HOWELL

DECEMBER 14, 1962

PACIFIC PLANTRONICS
SANTA CRUZ, CALIFORNIA

REF : MEMO DWP/SDM DATED DECEMBER 13TH

On record I am putting on paper my thoughts as expressed to you verbally in respect to the next move on our part.

Even though the overall conception of the Plantronics headset was finalized by an "upstart" in the headset industry, it would be foolish for us not to admit that the headset has created a a great deal of ~~industry~~ interest among headset users. As demonstrated in our own laboratory, it is so light that you hardly know when it is on your head and its qualities from an electrical and acoustical standpoint are certainly adequate for a great many uses. As a matter of fact, in the report covering the New Products Committee Meeting held November 9th a "Plantronic type of headset" was fifth on the list out of a total of 25 suggestions as possible new items to be considered for development.

In spite of the fact that nearly $400,000 allegedly has been put into Plantronics since they started, it would seem to me that we should at least approach them to get some indication of what their thoughts might be in respect to a possible acquisition-or merger-arrangement. I see no reason why we should hesitate to admit that the general concept of their design is one that has created some interest in the field even to the extent of our being approached from a number of areas to come up with something similar except engineered to fit their particular application. This application-engineering is, of course, the thing that they are going to have trouble with, and one of your recent memorandums indicates they are readily appreciate this. In talking with them, it would seem to me the point to stress is that now that they have created the initial interest, we are going to be forced to get into the picture sooner or later in one or another way, and I don't think there is any question but what they would recognize the fact that in the field of specification type headsets, Roanwell, as a competitor, would represent a pretty strong force and, therefore, it would seem only logical they would give very serious consideration to a reasonable tie-up.

and R

F 0773

R. W. H.

RWH/rr
CC SD Maddock

00261

617

F 862 (In Custody of Defendant's Counsel)

618

99

F 863 (In Custody of Defendant's Counsel)

619

100

COMPETITOR'S FILE

HCP
HWC
RTE
HCM

620

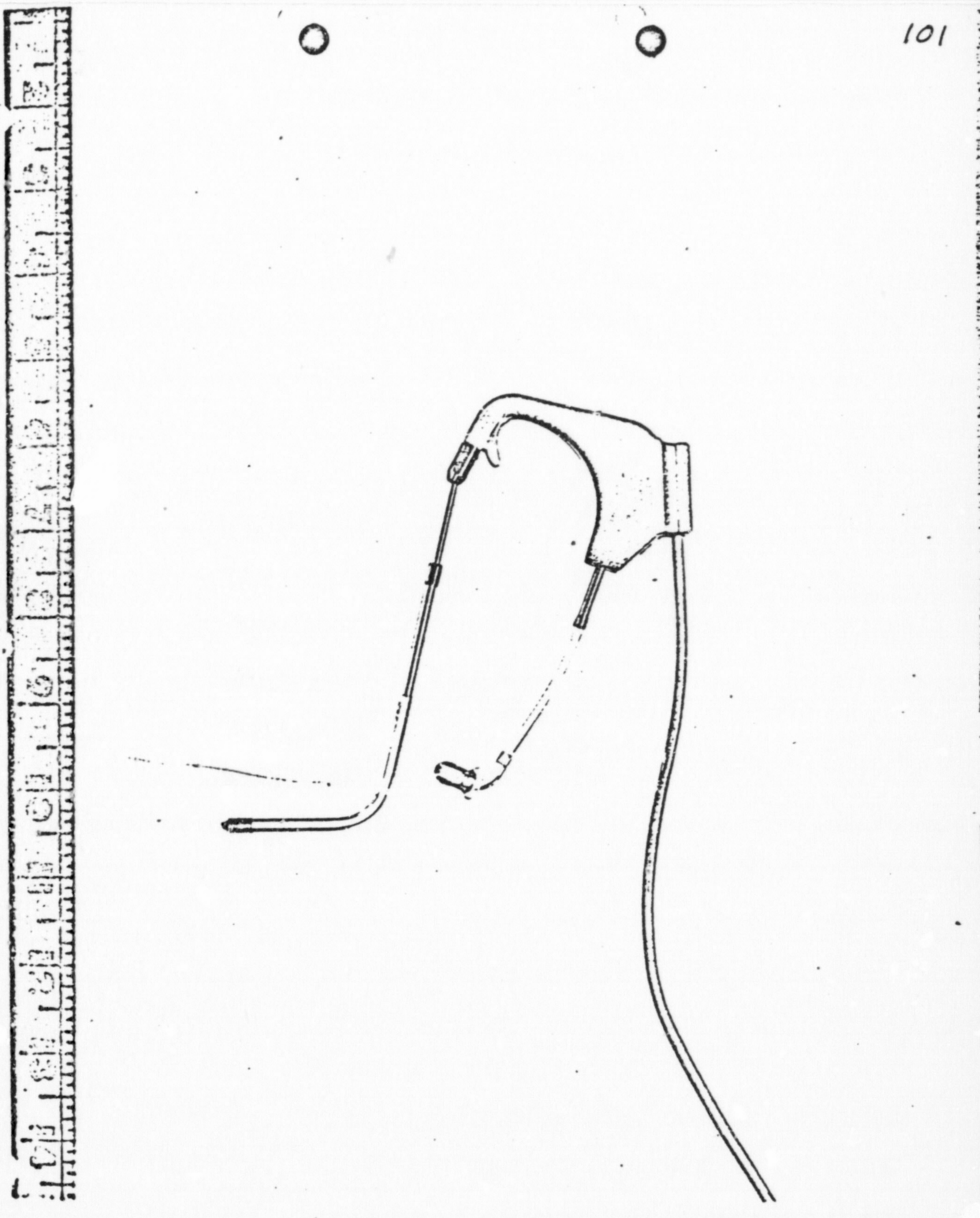


Photo of EP1167
F864
[illegible] F2(933 PD281-2

Rodnwell R-70

621

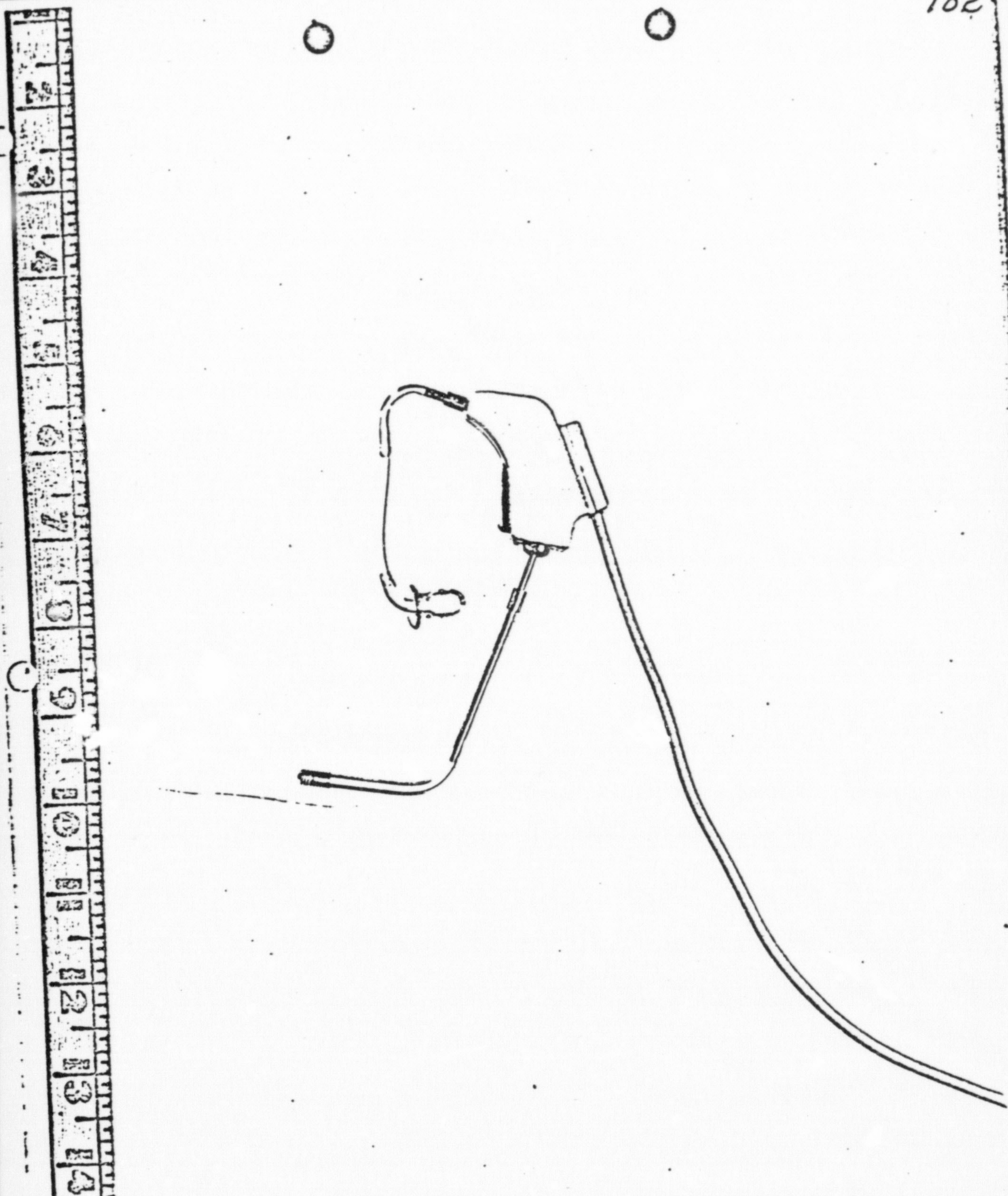
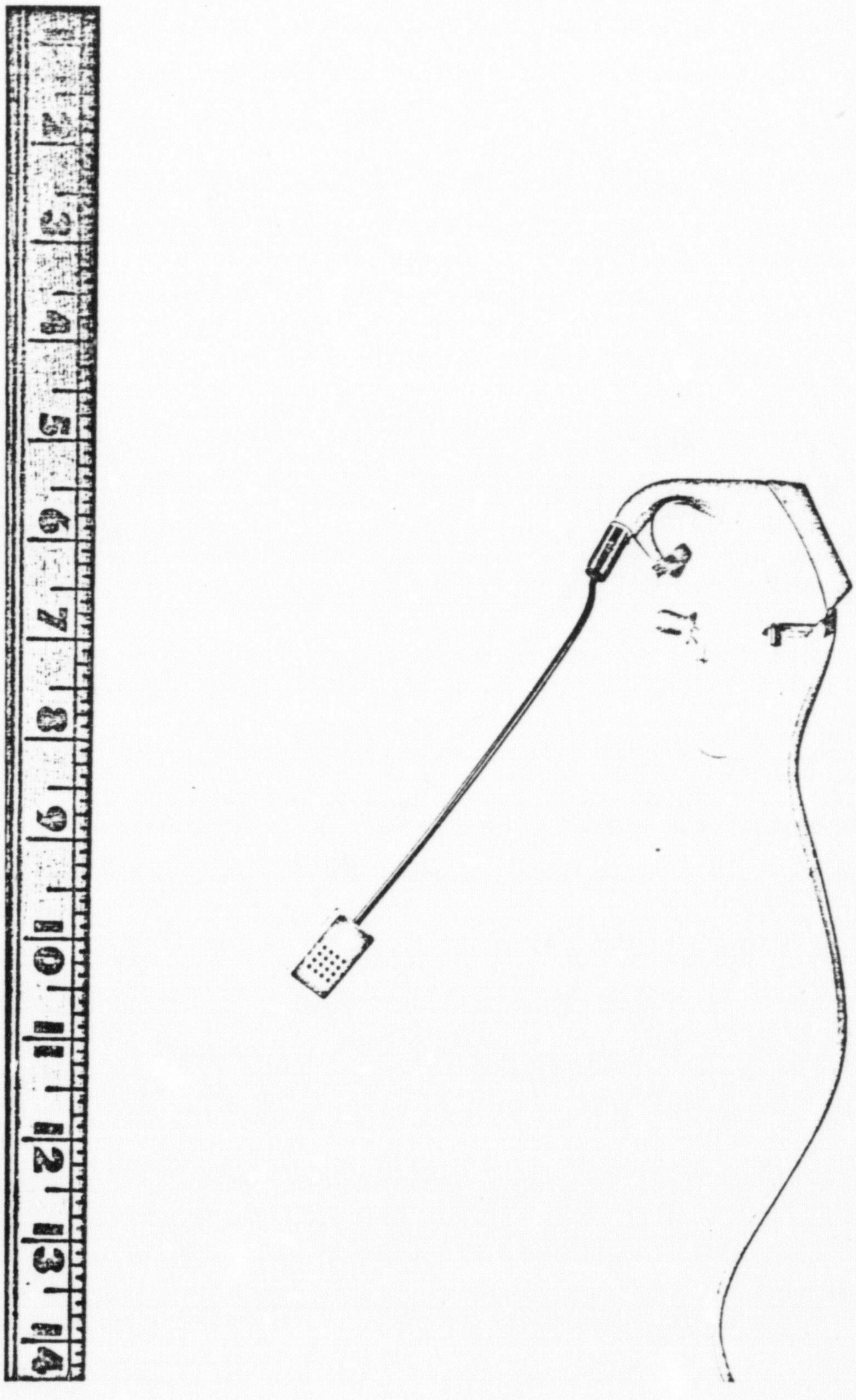


Photo of EP1168 F865

Loanwell R-71

822

PLAINTIFF'S
EXHIBIT
Photo of
141



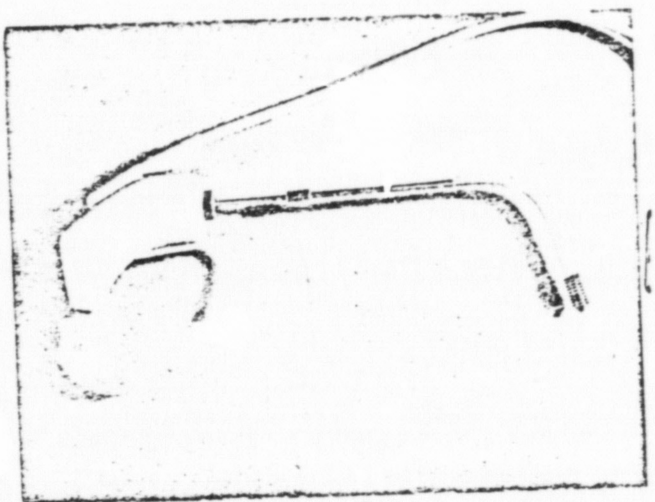
Ex. 141

623

PLAINTIFF'S EXHIBIT 143

MAR 10 1975

These pictures were [illegible]
in the [illegible] of [illegible]
in Court



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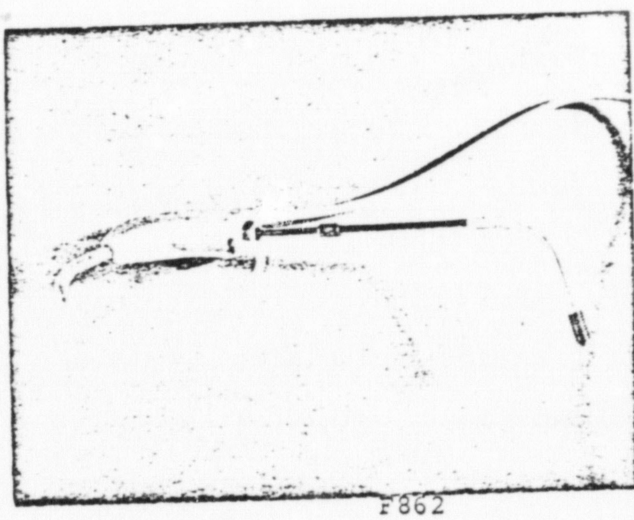

F862

Ex. 143

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PLAINTIFF'S
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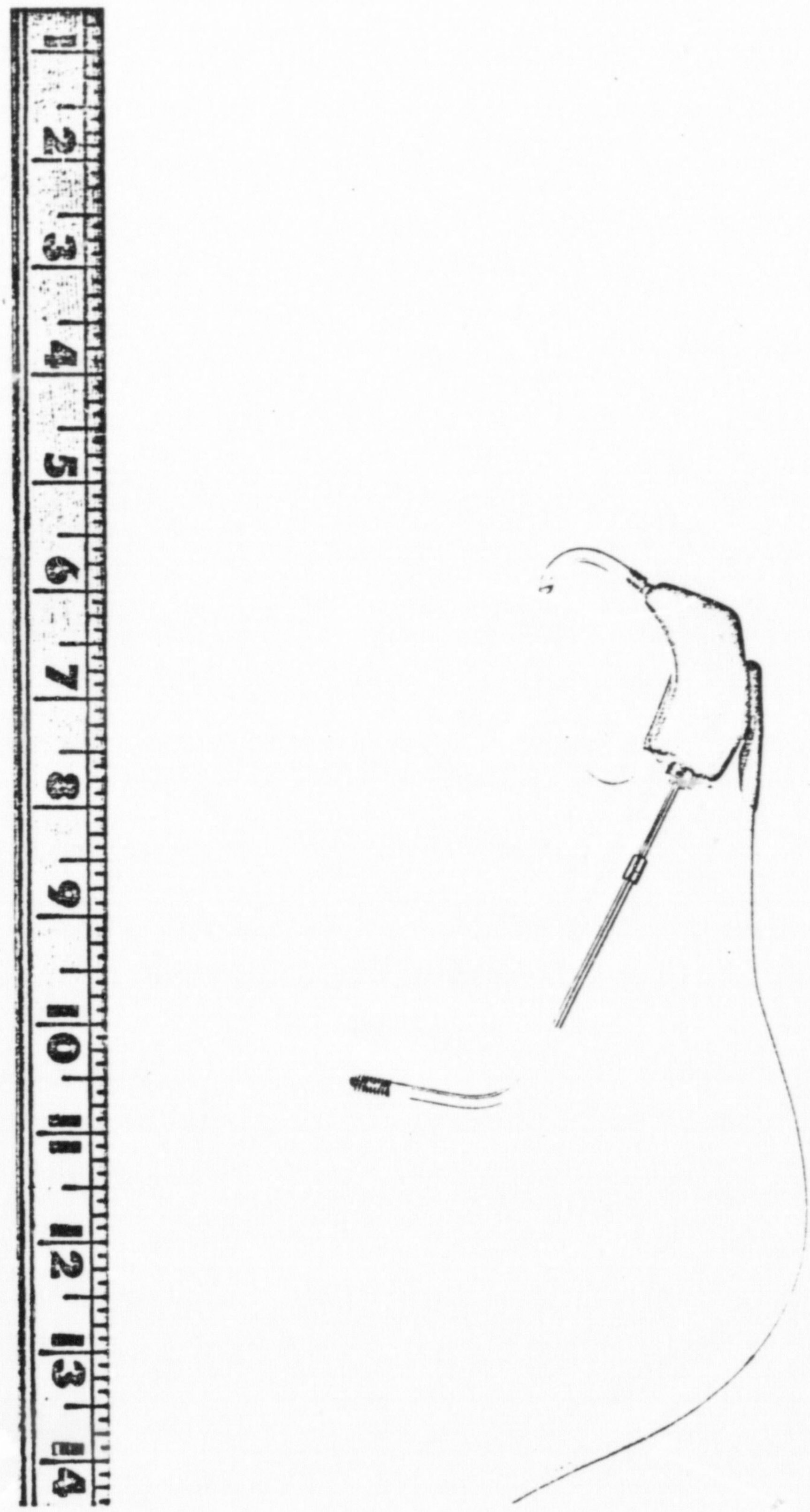
Photo OF
143A



Ex. 143A

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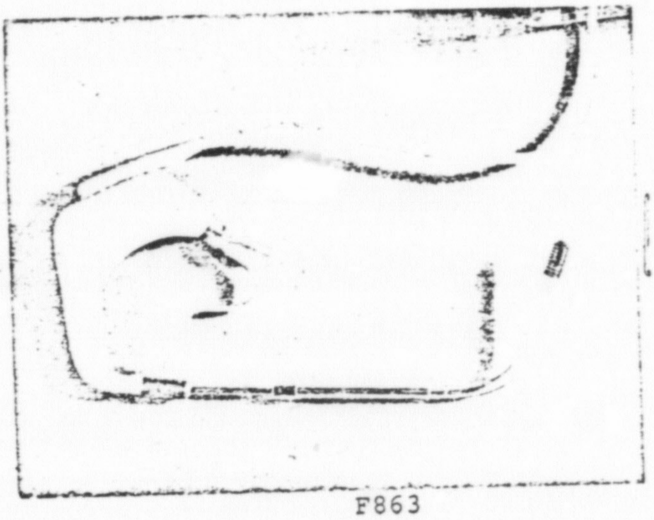

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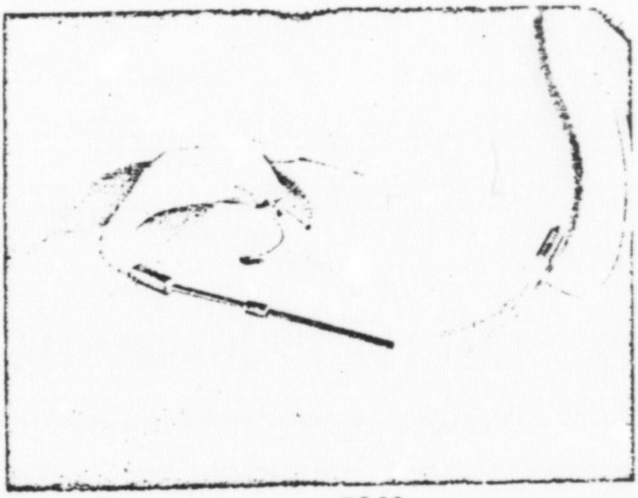

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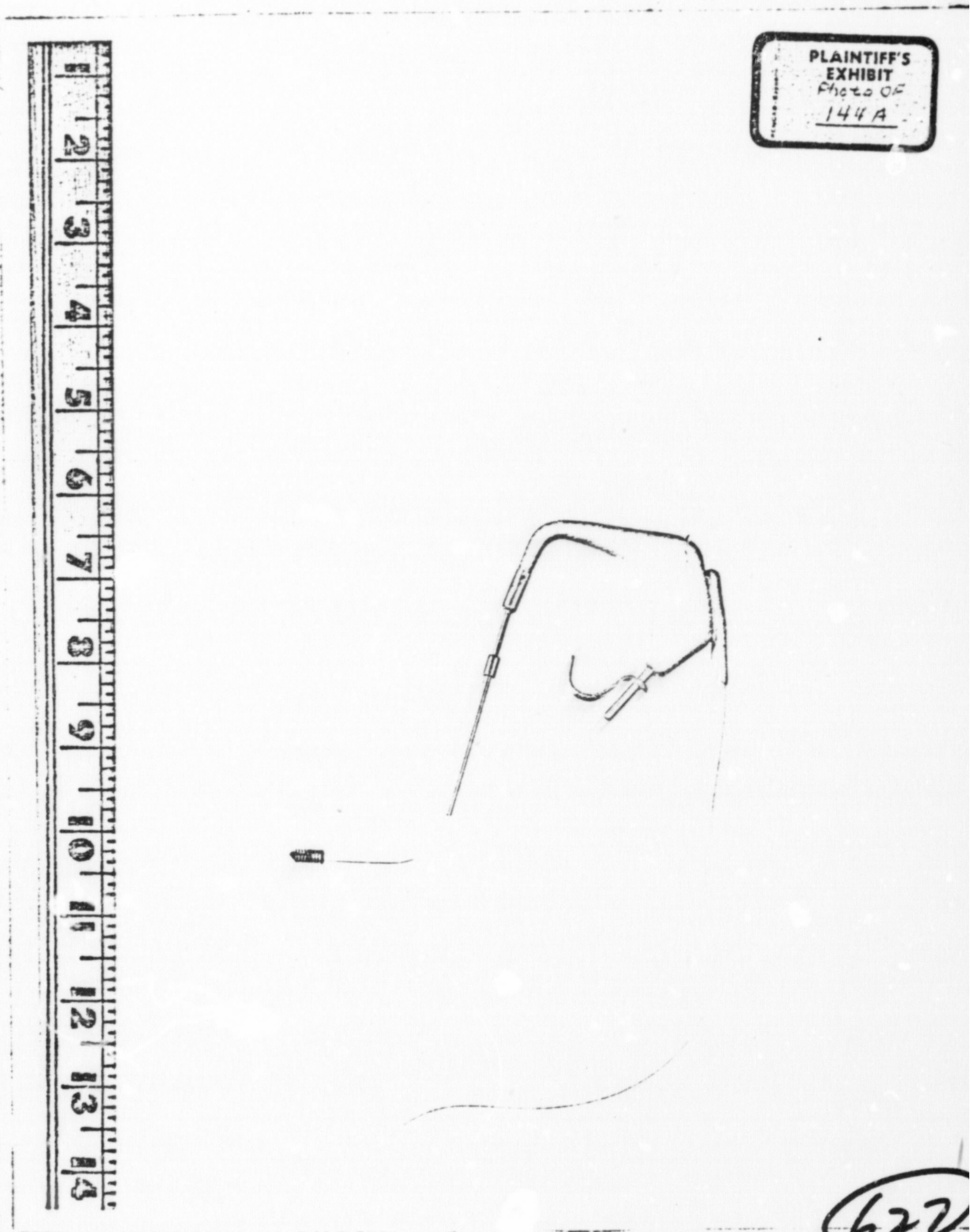
Ex. 144
626



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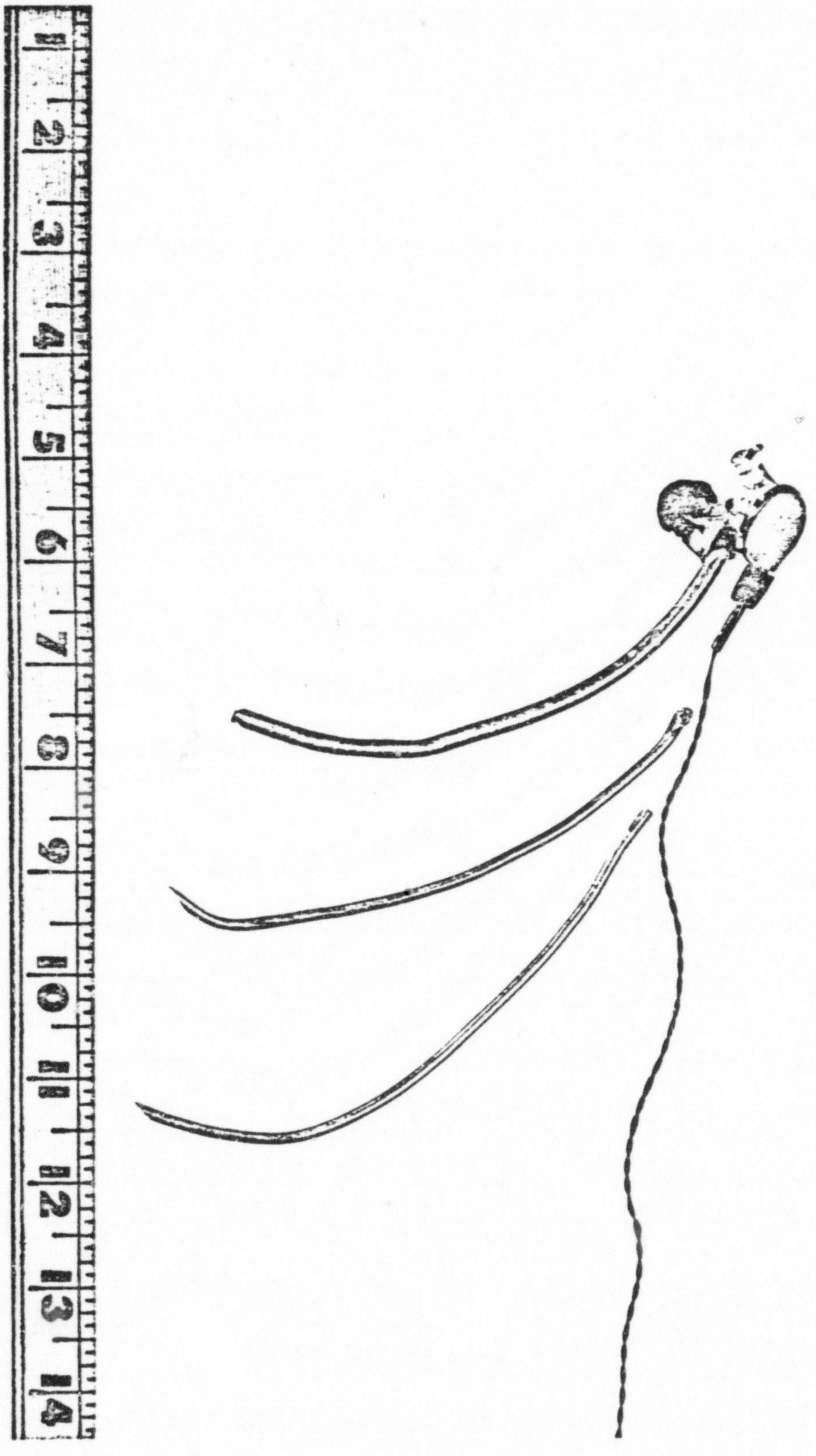
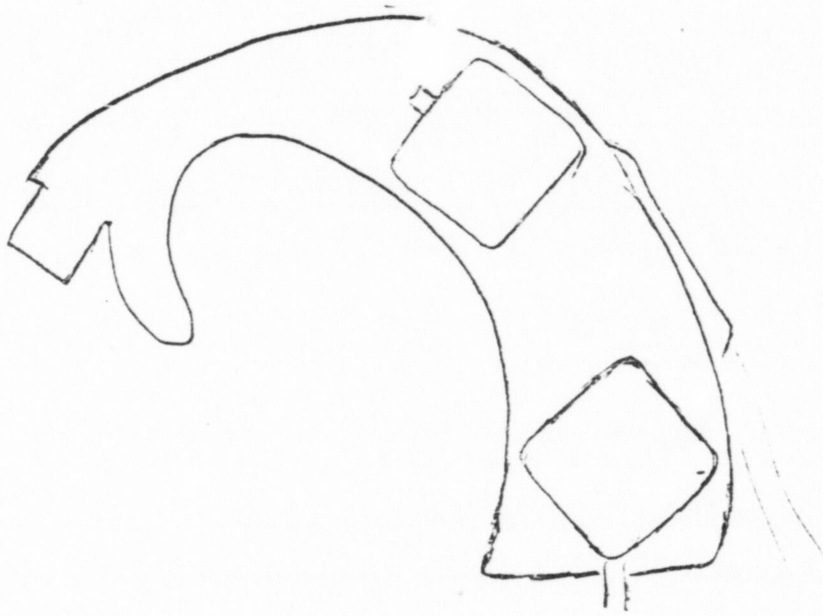


PLAINTIFF'S
EXHIBIT
Photo OF
146

Ex. 146

628

PLAINTIFF'S EXHIBIT 151



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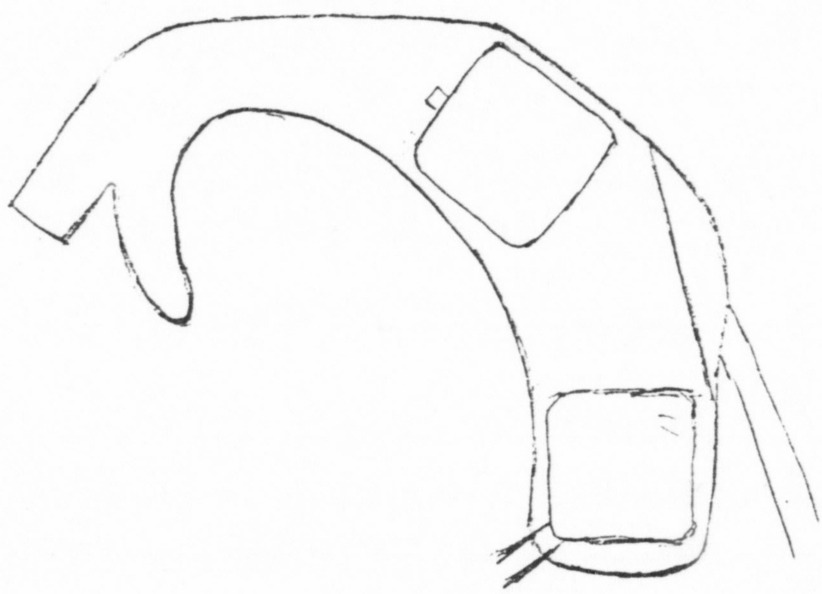
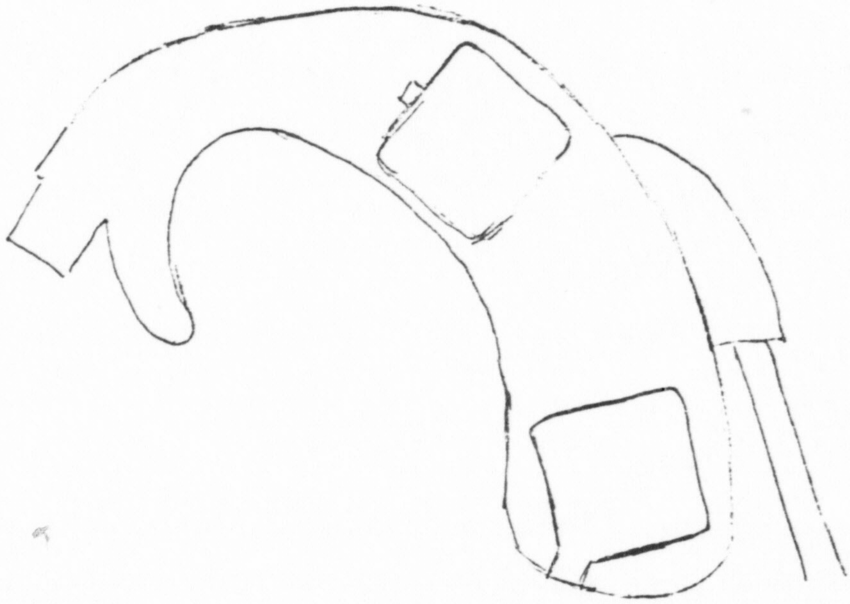
PLAINTIFF'S EXHIBIT 152



2:1 Ex. 152

630

PLAINTIFF'S EXHIBIT 153



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Ex. 153

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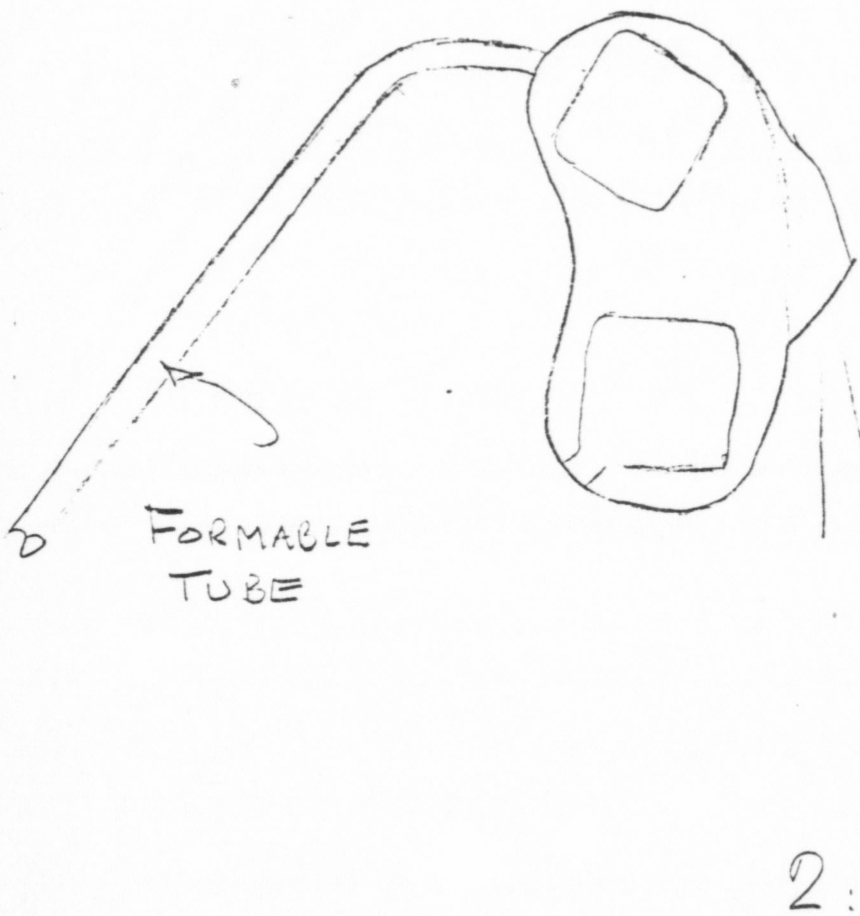
PLAINTIFF'S EXHIBIT 154



2:1

Ex. 154

632

PRIOR ART BOOK

RE

LARKIN PATENT NO. 3,184,556

1. British Pritchett patent No. 191, dated 1878

2. Olney et al patent 2,485,405, granted October 18, 1949 (with an Olney et al article entitled "The Dipole Microphone", in The Journal of the Acoustical Society of America, January, 1945, pages 172-7, and pages 98 and 102 of the July 1944 issue of the Journal concerning the presentation of this article in May of 1944)

   (a) Martin patent 2,592,562, granted November 14, 1950

   (b) Gilbert patent 2,586,644, granted February 19, 1952, with Telex sales flyer 381008 (Rev. 10-55) and Telex brochure Form 38500 (Rev. 2-59)

   (c) ARINC publication entitled "Lightweight Headset and Boom Microphone", designated ARINC Characteristic No. 535, issued March 25, 1957

3. Spencer-Roberton article entitled "A Light-weight Headset for Telephone Operators", in The Post Office Electrical Engineers' Journal, October 1960, pages 177-180 (with British patents 776,896 and 716,801)

4. Dreher et al patent 2,904,640, granted September 15, 1959

   (a) S.F. Lybarger article entitled "The Earmold as a Part of the Receiver Acoustic System", in The Radioear Voice, October 1958, pages 2-12

   (b) Henderson patent 2,939,923, granted June 7, 1960

   (c) Ohio State University Research Foundation Technical Report No. 36 (TN 56-57), dated October 1956 (with pages 313 and 330 of U.S. Government Research Reports, dated June 13, 1958, concerning the availability of this Report)

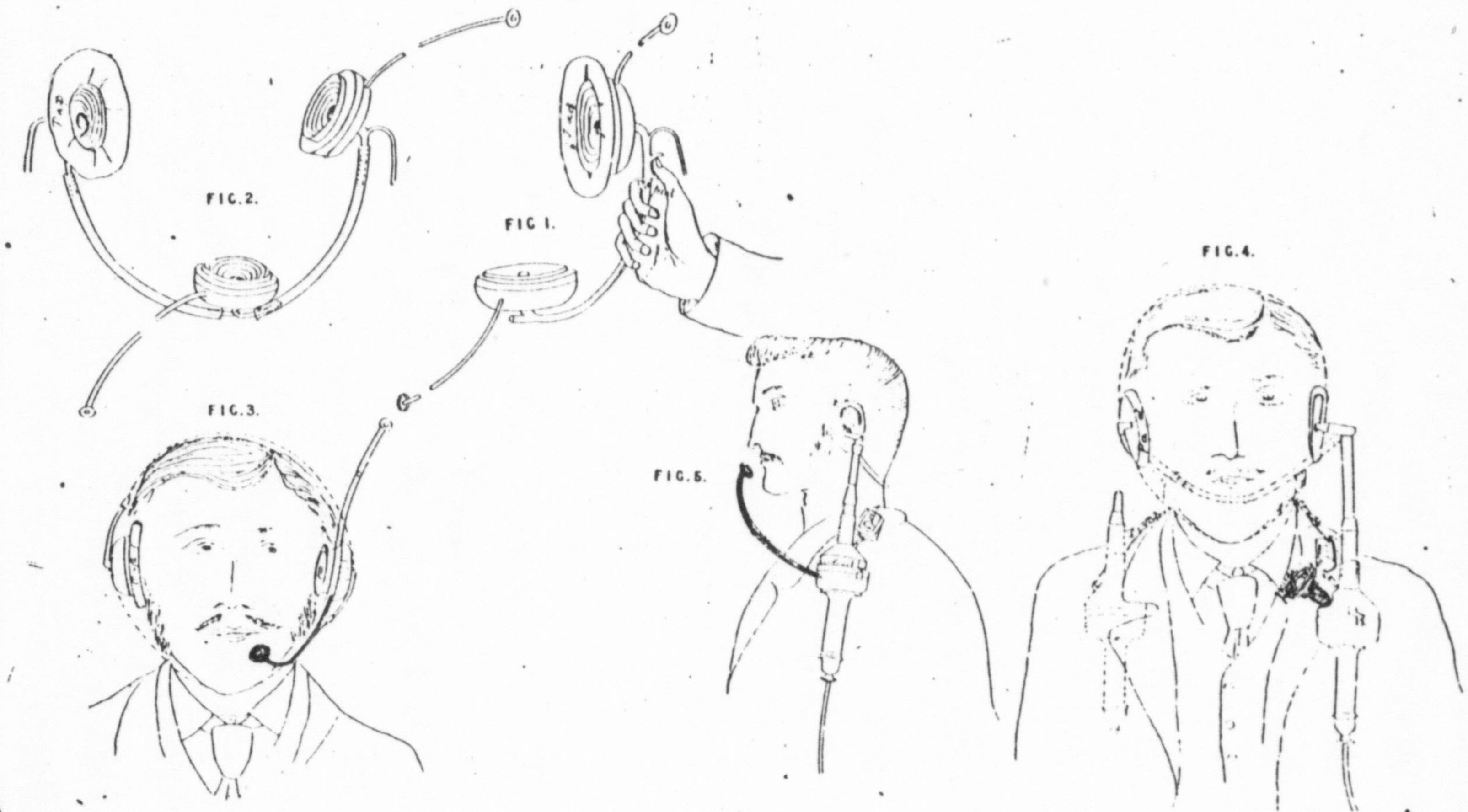
5. Guttner et al patent 3,209,080, filed June 29, 1961, granted September 28, 1965

Ex. C

633

A. D. 1878. Jan. 15. Nº 191.
PRITCHETT'S SPECIFICATION.

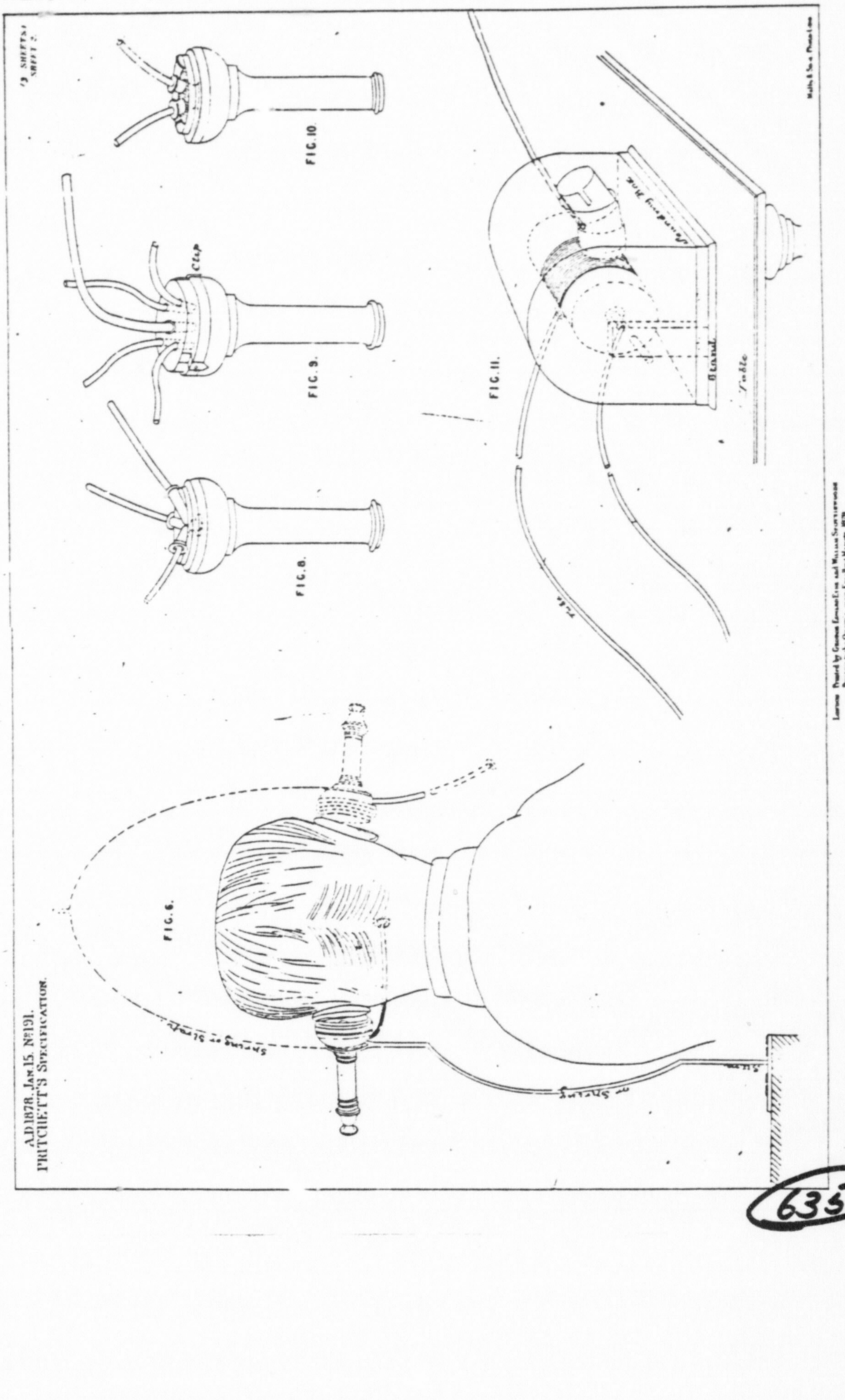
(3 SHEETS)
SHEET 1



634

Malby & Sons, Photo-Litho.

London: Printed by George Edward Eyre and William Spottiswoode, Printers to the Queen's most Excellent Majesty. 1878.



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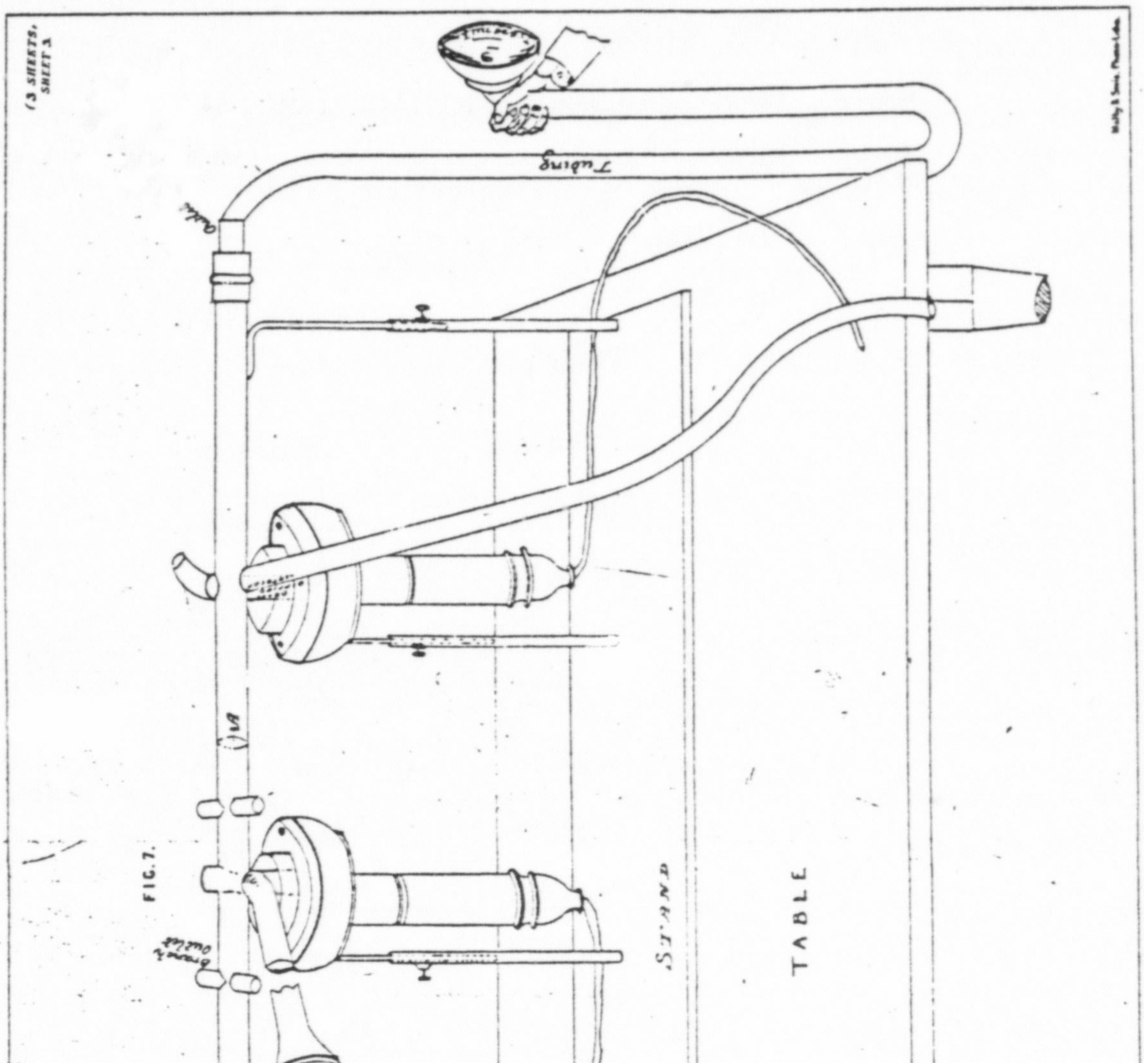
Patented Oct. 18, 1949

2,485,405

ends of the tubes are terminated with acoustical cussed hereinafter. The cavities 12 and 13 com-



636

ends of the tubes are terminated with acoustical cussed hereinafter. The cavities 12 and 13 com-

A.D. 1878, 15th January. N° 191.

Appliances for Utilizing and Conveying Sounds or Signals from Telephonic or Sound-producing Instruments.

LETTERS PATENT to George Edward Pritchett, of Bishop Stortford, in the County of Herts, Architect, for the Invention of "New or Improved Means, Apparatus, or Appliances for Utilizing and Conveying Sounds or Signals from or to Telephonic or Phonographic Sound-producing or Signalling Instruments."

Sealed the 22nd March 1878, and dated the 15th January 1878.

PROVISIONAL SPECIFICATION left by the said George Edward Pritchett at the Office of the Commissioners of Patents on the 15th January 1878.

George Edward Pritchett, of Bishop Stortford, in the County of Herts, Architect. "New or Improved Means, Apparatus, or Appliances for Utilizing and Conveying Sounds or Signals from or to Telephonic or Phonographic Sound-producing or Signalling Instruments."

This Invention comprises means or methods of imparting and revealing sounds, articulate speech, musical or other sounds or signals emanating from or produced by telephonic, phonographic, and sound-producing instruments and apparatus, so as to put the sounds or signals into audible or open communication with a number of persons simultaneously. This may be effected by placing a cap, caps, or covers, or other similar appliances of suitable dimensions, construction, and materials in close connection with, or in such convenient position or positions with respect to the telephonic and phonographic instruments and apparatus as to catch the words, sounds, and signals emanating from or produced by the instruments and apparatus aforesaid. From these caps, cap, or covers a number of tubes or channels of various sizes or lengths may be branched by being inserted, screwed, or secured into the said cap or covers, or into the telephonic and phonographic instruments and apparatus, below or above the discs, and terminated or fitted with ear-pieces, mouth-pieces, and valves, or otherwise.

[*Price* 8*d*.]

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minal resistances 40 to mechanical damage. Since

plitude, as well as phase differences at the dipole ends. For sounds arriving from a distance, how-

It follows, that when the telephonic and phonographic sounds, words, or signals are produced or received by the instruments or apparatus aforesaid, the tubes or channels attached to the said cap, caps, or covers, or telephonic and phonographic instruments, will convey the sounds, words, or signals emanated or signalled to a distance from the instruments or apparatus to a number of persons using the instrument where required.

Such tubes, and mouth-pieces, and ear-pieces, can also be used and attached for speaking into and listening to such instruments from a distance simultaneously, and thus authenticated copies of messages or signals sent could be taken down in writing, or listened to by persons in different places.

For example, several reporters to newspapers, or other persons, may severally have the use of one or more tubes or channels, and mouth-pieces and ear-pieces, running from the cap, caps, or covers or instruments as before mentioned, which, if adjusted or fixed to his or their persons or ears, having light ear-pieces and pads with springs, or otherwise, so as to shut out external sounds, stillness would be secured to him or them, and one telephonic and phonographic instrument, from which sounds, words, or signals emanate or are signalled, would answer the purpose of a multiplicity of telephonic and phonographic instruments and apparatus, as several persons would, one and all, be able to hear the same messages, words, or signals, or sounds at the same time, although in different places. The messages words, or signals received could thus be attested, registered, and accuracy ensured at the moment of emanation or delivery.

It will be evident that the hands of the reporters or others will be free, from not having to hold any instruments, as the tubes or channels aforesaid will be attached to or brought into close proximity to their ears, mouths, or persons from the telephonic and phonographic instruments, which could be fixed. Thus, their fingers will be free and ready to write or manipulate other instruments, apparatus, &c., as required, at the same time as the words, sounds, or signals are in emanation from the telephonic and phonographic instruments or apparatus.

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tion entirely.

SPECIFICATION in pursuance of the conditions of the Letters Patent filed by the said George Edward Pritchett in the Great Seal Patent Office on the 15th July 1878.

GEORGE EDWARD PRITCHETT, of Bishop Stortford, in the County of Herts, Architect. "NEW OR IMPROVED MEANS, APPARATUS, OR APPLIANCES FOR UTILIZING AND CONVEYING SOUNDS OR SIGNALS FROM OR TO TELEPHONIC OR PHONOGRAPHIC SOUND-PRODUCING OR SIGNALLING INSTRUMENTS."

This Invention comprises means or methods of imparting and revealing sounds, articulate speech, musical or other sounds or signals emanating from or produced by telephonic, phonographic, and sound-producing instruments and apparatus, so as to put the sounds or signals into audible or open communication with a number of persons simultaneously. This may be effected by placing a cap, caps, covers, cases or other similar appliances of suitable dimensions, construction, and materials in close connection with or in other convenient position or positions with respect to the telephonic and phonographic instruments and other apparatus, so as to catch the words, sounds, and signals emanating from, conveyed, or produced by the the instruments and apparatus aforesaid. From these caps, cap, or covers a number of tubes or channels of various sizes or lengths may be branched by being inserted, screwed, or secured into the said cap, caps, covers, or cases, or into the telephonic and phonographic instruments and apparatus, below or above the discs, and terminated or fitted with ear-pieces, mouth-pieces, valves, and circuit breaks or otherwise.

It follows that when the telephonic or phonographic sounds, words, or signals are produced or received by the instruments or apparatus aforesaid, the tubes or channels attached to the said cap, caps, or covers or telephonic and phonographic instruments will convey the sounds, words, or signals emanated or signalled to a distance from the instruments or apparatus to a number of persons using or listening to the instrument where required.

Such tubes, and mouth-pieces, and ear-pieces, can also be used and attached for speaking into and listening to such instruments from a distance simultaneously, and thus authenticated copies of messages or signals sent could be taken down in writing, and listened to by persons in different places.

For example, several reporters to newspapers, or other persons, may severally have the use of one or more tubes or channels, and mouth-pieces and ear-pieces, running from the cap, caps, or covers or instruments as before mentioned, which if adjusted or fixed to his or their persons or ears (having light ear-pieces and pads with springs or otherwise, so as to shut out external sounds) stillness would be secured to him or them, and one telephonic or phonographic or other sound-producing instrument or instruments from which sounds, words, or signals emanate by being boxed or cased in, or are signalled, would answer the purpose of a multiplicity of telephonic, phonographic, or other sound-producing or conveying instruments and apparatus as several persons would, one and all, be able to hear the same message, words, or signals, or sounds from the same telephonic or phonographic instrument at the same time. The messages, words, or signals received could thus be attested, registered, and accuracy ensured at the moment of emanation or delivery.

It will be evident that the hands of the reporters or others will be free from not having to hold any instrument, as the tubes or channels aforesaid will be attached to or brought in close proximity to their ears, mouths, or persons from the telephonic and phonographic or other instruments which could be fixed. Thus, their fingers will be free and ready to write or manipulate other instruments, apparatus, &c., as required, at the same time as the words, sounds, or signals are in emanation from the telephonic or phonographic or other instruments or apparatus.

Having thus far described my Invention, I may remark that my new, improved, and combined sound-producing, transmitting, and receiving instruments, apparatus,

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From Fig. 25 and Kirchhoff's laws:

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sistance, the one nodal diameter mode of vibration entirely.

and appliances alluded to may be placed at any convenient distances or number of miles apart, and may be brought into use or worked by any method or medium, so as to produce the required and strengthening effects, and same may vary in size, shape, dimensions, and materials.

For the new adaptations and combinations aforesaid one mode I adopt, shewn by Fig. 1 of the Drawing accompanying this Specification, is to bend a steel or iron rod or rods, jointed or otherwise, towards or at its or their centres, or elsewhere, and supplied with or without soft iron cores and coils, bobbins, and discs, in such a curvilinear or angular manner and proportion as to allow mouth and ear pieces or caps, with finials, pads, and appliances to fit to the ear or ears and mouth of the user when placed there, so as to form both transmitting and receiving instruments or instrument to be used at the same time without shifting it or them from the ear to the mouth, or *vice versa*.

This duplex form and combination can be held by the hand or hands, or otherwise fixed, the pressure of the fingers on the jointed, bent, or straight rod or rods (which may be magnetized or otherwise) being sufficient to adjust the instrument to the ear and mouth as required.

This adjustment may also be assisted by handles or knobs on the bar or stem (as shewn in Fig. 1).

These iron or steel rods can be covered with velvet or other suitable material, or decorated, as can also the cap and tubing.

This instrument can be folded up, so as to go readily into the pocket, or into a small case or box.

To apply this duplex instrument to both the ears and the mouth another new adaptation and combination (see Fig. 2) which I make use of is to attach a second rod, mounted with mouth and ear pieces similar to those already described, and as shewn in said Fig. 2, and thus form it into a triple instrument. These caps or ear-pieces can be padded as aforesaid, and applied to the ears, so as to shut out external sounds (as also shewn in Figures 1 and 2), which will much aid the receiver in hearing sounds and messages, whilst to transmit sounds or articulate speech it will only be necessary to move or adjust the instrument by the handles at A, B, to the mouth, so as to speak into the instrument in its duplex or triple form without shifting it or them from the ear to the mouth, or *vice versa*.

In order to lighten these instruments elastic tubing, light springs, or other materials may be introduced between the rods or parts with advantage, as also shewn in Fig. 2.

To put two or more persons into communication with this instrument or these instruments, tubes of various sizes and suitable lengths, with ear and mouth pieces, are also introduced into the caps as required (as shewn in Figs. 1 and 2).

Another new adaptation and combination is to have one or two caps and steel or iron rods, as aforesaid, so as to fit the ear or ears, and with pads or otherwise, so as to shut out external sounds. These may be connected or fixed by straps, tubes, bands, or springs, and fastened by these passing over the head and under the chin.

Tubes may be inserted in the caps, as aforesaid, both for purposes of transmitting and receiving sounds. The hands of the person or persons using this instrument, or these instruments will thus be free to write or manipulate with other instruments, as required. This method and combination is illustrated in Fig. 3.

Another new adaptation and combination (see Fig. 4) I make use of is to cap telephonic instruments with conical or segmental caps, or enclosures of other shapes, made with metal, ebonite, or suitable materials, and having a tube or tubes (elastic or otherwise) terminated with ear finials and pads to cover the ear or ears of the person using them, so as to shut out sounds. Mouth-pieces or tubes adapted for transmitting sounds or messages will be branched and fixed on the caps, and adapted for the use of the mouth (as shewn at A in said Fig. 4).

The telephonic instruments when used in this adaptation and combination can or will be fastened by a clip, strap, or otherwise to the collar or garment of the

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2,485,405

11 12

a pressure gradient microphone to provide a com- watts per square centimeter of sound power pass-

user, either on the left or right side; or there will, by preference, be two telephonic instruments in use, one on each side (as shewn by dotted lines in Fig. 4) with caps and tubes, which may reach to the ears as aforesaid, and the two instruments be connected with a band or strap across the shoulders, as shewn, or by clips as aforesaid.

In the case of one telephonic instrument only being in use, and attached on the left or right side of the garment of the user, the tubing attached to the cap may or will be branched; or this may be done by tripod pieces or otherwise, and conveyed to the right or left ear by passing at the back of or over the head or under the chin of the user, where it will be fixed by a band or straps and supplied with pads and ear-pieces as aforesaid; thus the hands of the person or persons using the instrument, and to whom the instrument or instruments are fixed, will be free to write and manipulate with other instruments as required. This adaptation is also illustrated in Fig. 5, where only one branch piece is shewn by side elevation.

Another new adaptation and combination is to sling telephonic instruments by straps or bands, or fix them by or on a stem or spring, so that the user can bring or press the ear against one or both of them by adjustment.

Tubes can be inserted either below or above the discs, and may be used for transmitting and receiving purposes as required (and as shewn in Fig. 6).

Another new adaptation and combination (as shewn in Fig. 7) is to mount telephonic instruments, either vertically or otherwise, in or on a stand or table.

Above, or in connection with this telephonic instrument or instruments, is a circular or polygonal tube of metal or other material of any suitable or fitting size and dimensions, with outlets and branch outlets, as shewn in Fig. 7. One or more of such tubes, with outlets as aforesaid, can be lowered or adjusted to the caps or other portions of the telephonic instruments; or the telephonic instruments will be raised or lowered to or from the main tube as required, so as to utilize and convey the sounds emanating from or produced by the telephonic power by their passing into this main tube and branch tubes aforesaid, and thence into other and longer tubes (elastic or otherwise) with ear and mouth pieces as aforesaid, and as also shewn in Fig. 7.

Stops or dampers may be introduced into the main tube or elsewhere, so as to use one or more instruments at the same time (as shewn at A, Fig. 7). Persons using these tubes, to which mouth and ear pieces may or will be attached, and fixed or held to their ear, or adjusted to their mouth, by any of the methods aforesaid, will one and all hear the sounds, articulate speech, music, &c., emanating from the telephonic instrument aforesaid, of which several may be in use at the same time, whilst their hands can or will be free for writing or manipulating with other instruments or otherwise as aforesaid.

The branches or tubes not in use may be stopped by plugs, valves, or otherwise.

Another new adaptation and combination (see Fig. 8) which I make use of is to insert into the cap of telephonic instruments a piece of tubing of appropriate size, preferably about three-quarters of an inch in diameter, and spread out at its bottom end, so as to fit closely down in the caps of the telephonic instruments, whilst its upper part or end is branched into several openings to receive tubes (elastic or otherwise) for the purpose of transmitting and receiving sounds. This tubing is secured to the case of telephonic instruments, as shewn in Fig. 8. Thus one telephonic instrument only need be in use instead of several.

Another new adaptation I make use of is to cap telephonic instruments with perforated cap or caps of ebonite, metal, or other suitable material, so as to insert into it or them one or a number of tubes or channels, which can be led away from it or them, and terminated by mouth and ear pieces, so that a number of persons may use the same simultaneously, either for transmitting or receiving sounds as aforesaid. This is illustrated in Fig. 9.

Another new adaptation I make use of (see Fig. 10) is to form with ebonite, gutta-percha, metal, or other convenient substances a cover or plug fitting into the top of the telephonic instrument, and leaving one, two, or more outlets or openings.

One of the outlets can be used for transmitting, and the other or others may be fitted with tubes or channels, and mouth and ear pieces, for the purpose of listening to and receiving sounds and messages. This mode and combination is illustrated in Fig. 10.

A similar adaptation and combination may be made use of without any telephonic instrument, technically so-called, and also with what are known as toy telephones influenced by vibratory motions, visible or invisible, by inserting a tube or tubes with suitable ear and mouth pieces into the material of the instruments, so that the telephonic instrument becomes a multiplex instrument in its effects, and several persons may use or avail themselves of a number of telephonic sounds and results simultaneously without shifting the instruments.

Similar adaptations and combinations in effect may also be used or applied to phonographic or any other sounding instruments by casing, boxing, or enclosing them with materials, such as wood, ebonite, metal, or other suitable substances, so that sounds will be condensed and strengthened, and will emanate and be conveyed from them and their casings and boxings through tubes or channels to distances less or greater, as may be required, and thus sounds or signals will be put into audible, free, and open communication with a number of persons simultaneously, as also shewn in Fig. 11.

And it may be here observed that this Invention, although it will be found to be of great utility to all persons who have to use telephonic, phonographic, microphonic, or such like instruments, will also be found to be of the greatest service to persons afflicted with deafness, as even the simpler forms of sound-conveying instruments could, by the adoption of my Invention, be increased in efficiency.

Relays can also be introduced where requisite.

Having now particularly described and ascertained the nature and object of the said Invention, and in what manner the same is to be performed or carried out in practice, I hereby declare that I claim substantially as herein-before set forth and described, the Invention of new or improved means, apparatus, or appliances for utilizing and conveying sounds or signals to and from telephonic, phonographic, or other sound-conveying, producing, reproducing, or signalling instruments, wherein the use and adoption of sounding instruments with enclosings, pads, boxings, tubes, branches, ear trumpets, and terminals arranged substantially as herein-before described (although open to variation in detail as to relays or otherwise) with the view of condensing, strengthening, and utilizing, and transmitting the effect of telephonic, phonographic, microphonic, and other sound-conveying, producing, reproducing instruments, is the important point or feature.

In witness whereof, I, the said George Edward Pritchett, have hereunto set my hand and seal, this Fifteenth day of July, in the year of our Lord One thousand eight hundred and seventy-eight.

G. E. PRITCHETT. (L.S.)

Witness,
T. MORGAN,
Secretary,
Inventors' Patent Right Assn., Limited.

LONDON: Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

1878.

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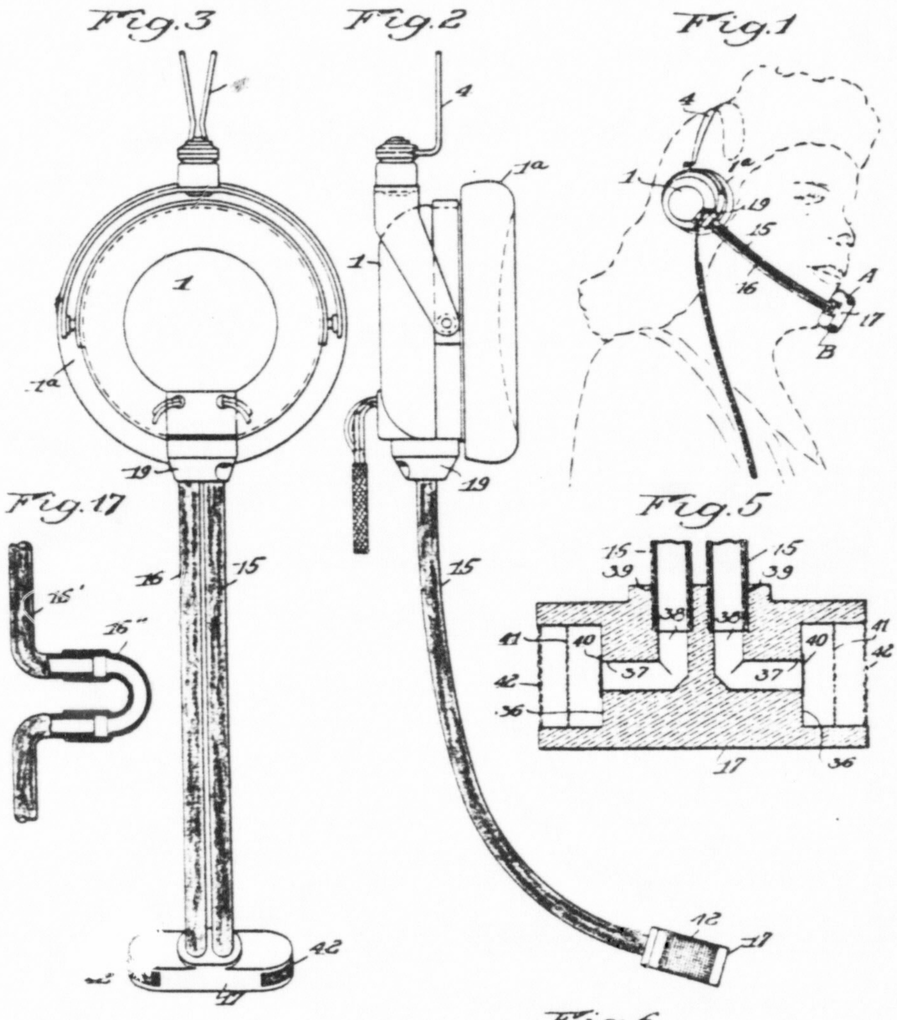
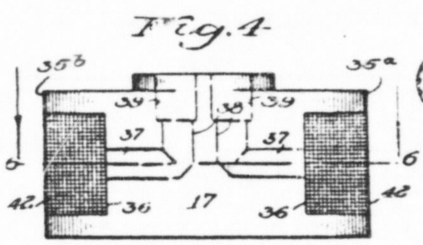
Oct. 18, 1949. B. OLNEY ET AL 2,485,405 2.

DIPOLE MICROPHONE

Filed April 21, 1944 6 Sheets-Sheet 1





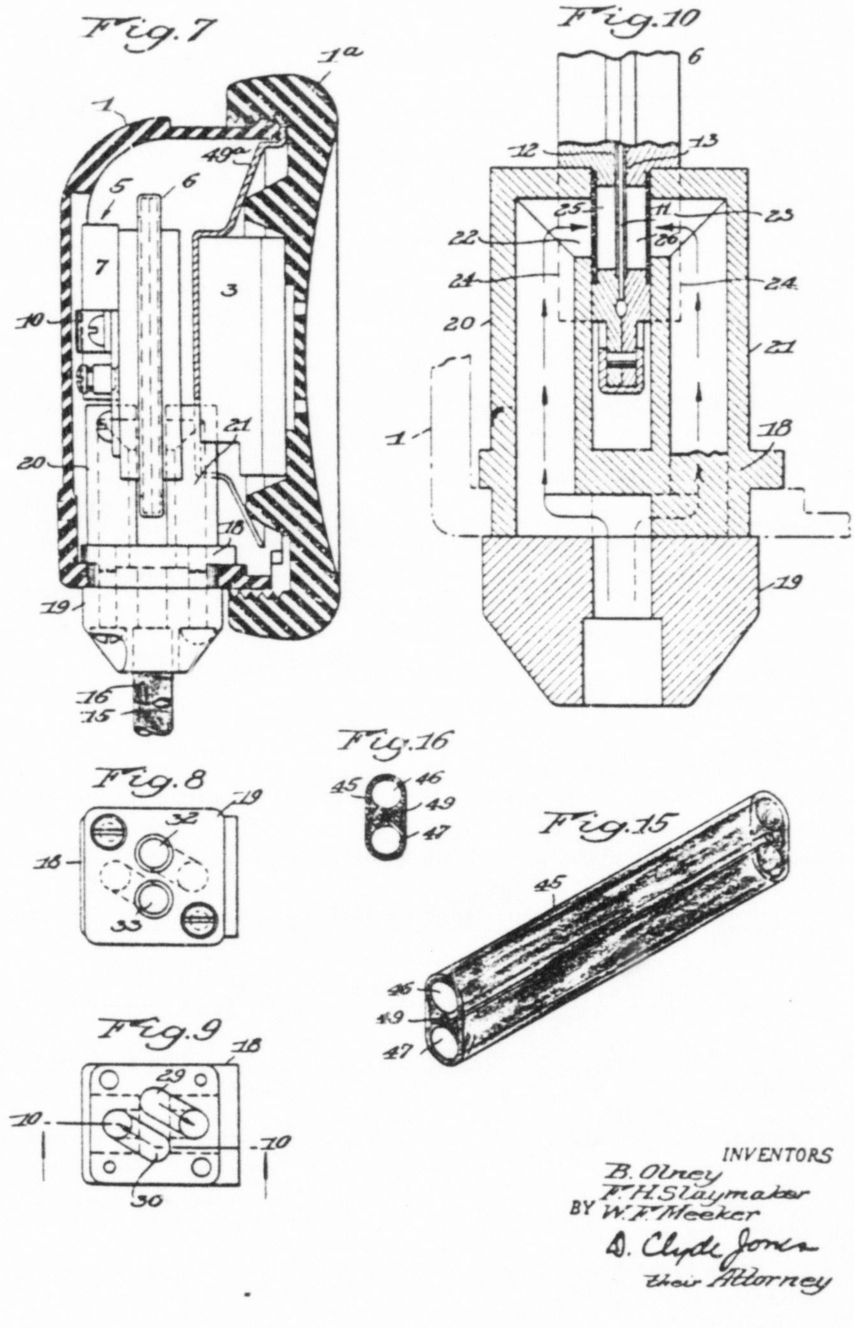
INVENTORS
B. Olney
F. H. Slaymaker
BY W. F. Meeker
D. Clyde Jones
their Attorney

643

Oct. 18, 1949. B. OLNEY ET AL 2,485,405

DIPOLE MICROPHONE

Filed April 21, 1944 6 Sheets-Sheet 2



INVENTORS
B. Olney
F. H. Slaymaker
BY W. F. Meeker
D. Clyde Jones
their Attorney

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Oct. 18, 1949. B. OLNEY ET AL 2,485,405

DIPOLE MICROPHONE

Filed April 21, 1944 6 Sheets-Sheet 3

Fig. 11

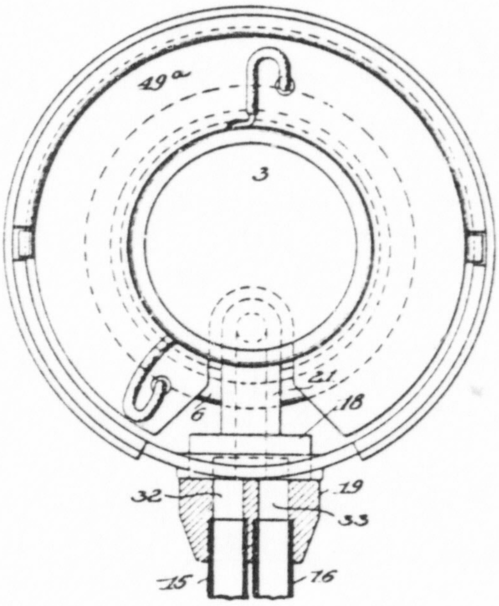


Fig. 12

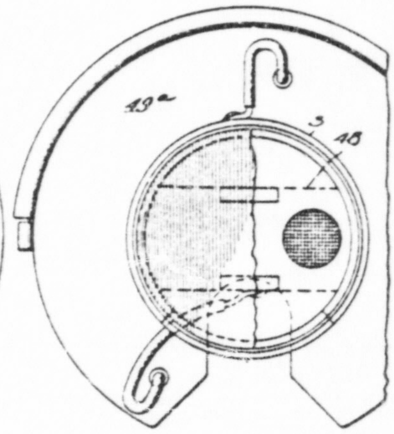


Fig. 13

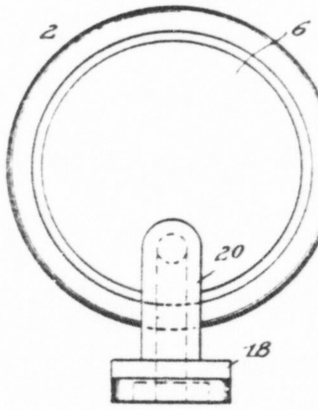
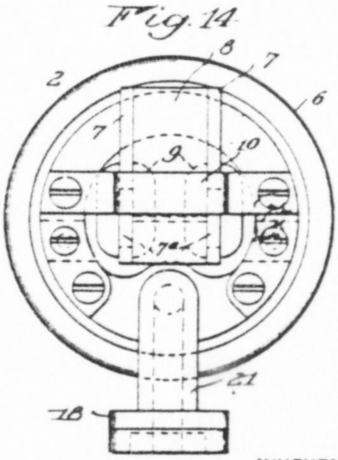


Fig. 14



INVENTORS
B. Olney
F. H. Slaymaker
W. F. Meeker
BY D. Clyde Jones
their Attorney

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Fig. 19

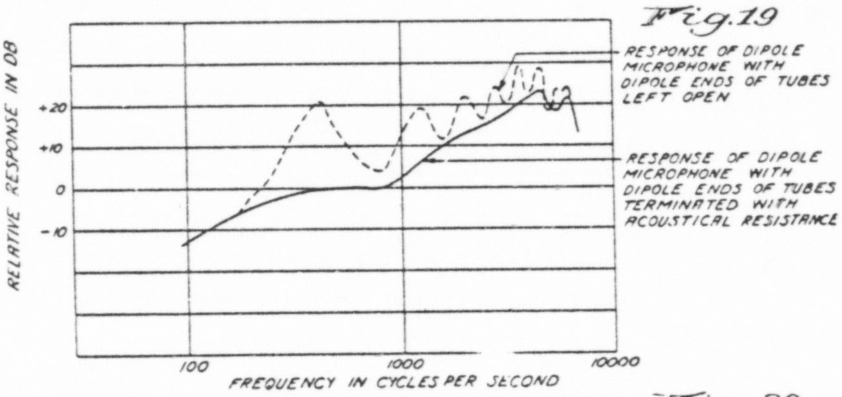


Fig. 20

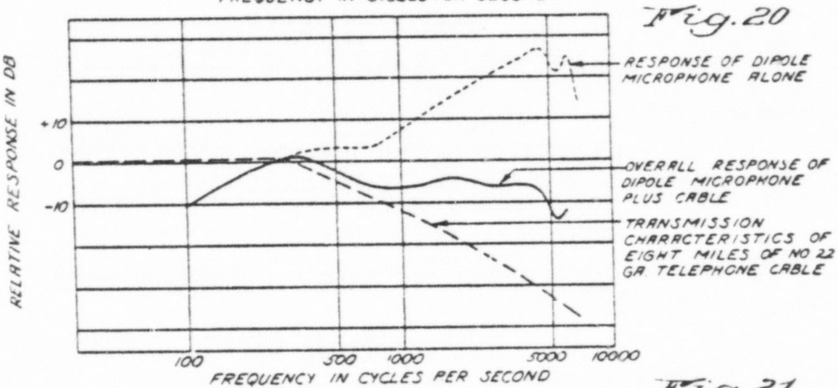


Fig. 21

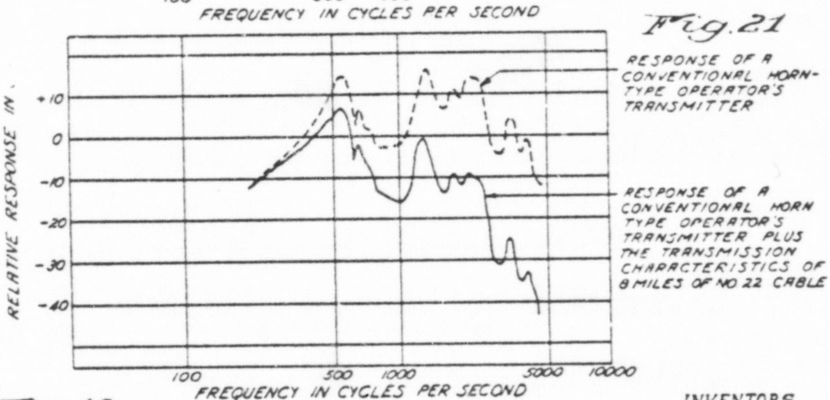
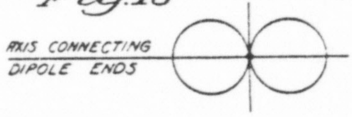


Fig. 18



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DIPOLE MICROPHONE

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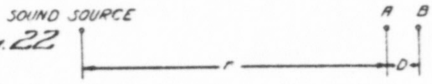
Fig. 22



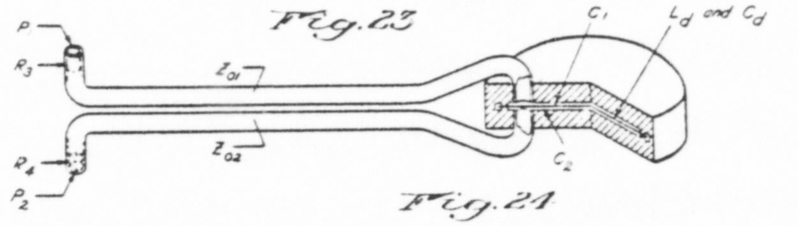


Fig. 24

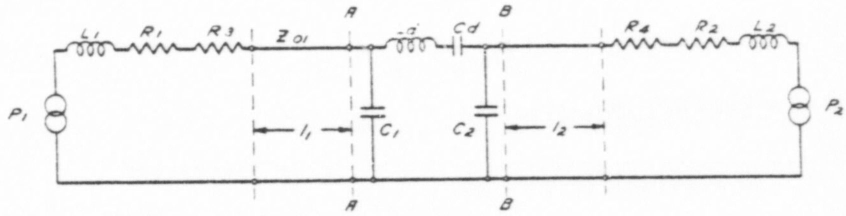


Fig. 25

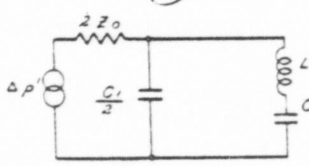


Fig. 26

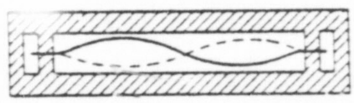


Fig. 28

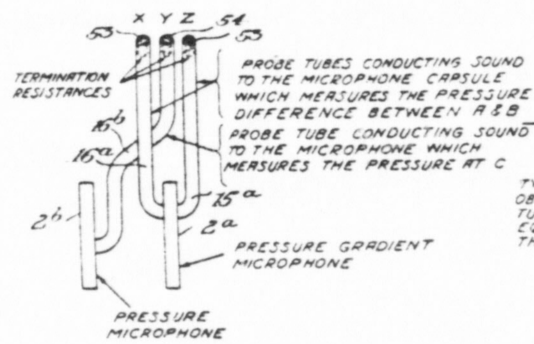
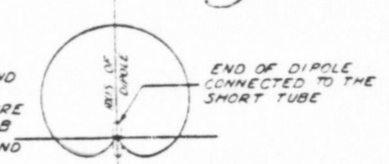


Fig. 27



TYPE OF DIRECTIONAL CHARACTERISTICS OBTAINED WHEN THE TRANSMISSION TUBES DIFFER IN LENGTH BY AN AMOUNT EQUAL TO THE DISTANCE BETWEEN THE DIPOLE ENDS.

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Fig. 29

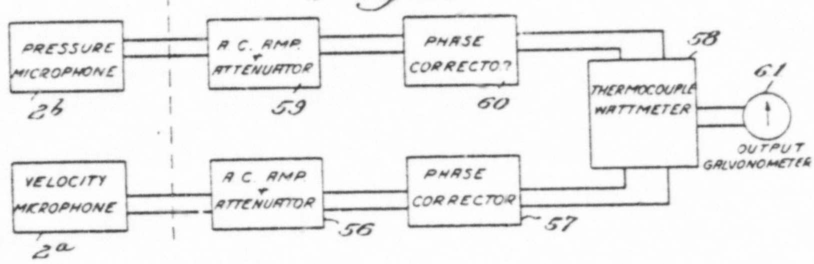


Fig. 30

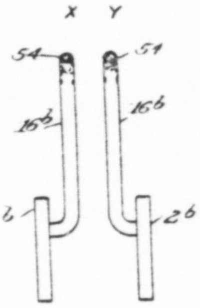
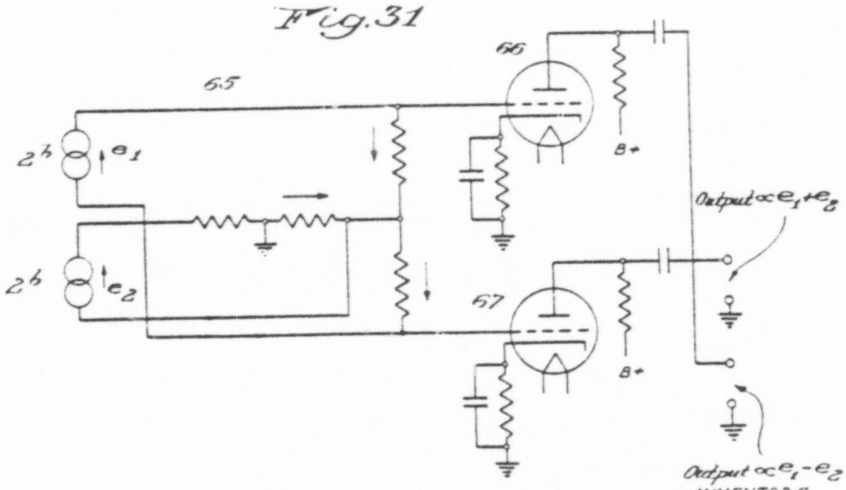


Fig. 31



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UNITED STATES PATENT OFFICE

2,485,405

DIPOLE MICROPHONE

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Application April 21, 1944, Serial No. 532,168

17 Claims. (Cl. 179—102)

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This invention relates to electro-acoustical transducers and especially to microphones and to similar sound pickup devices.

In telephone transmitters, acoustical wattmeters, acoustical impedance meters and similar devices, there is involved the problem of picking up energy from sound waves and conveying or applying it to a unit which translates it into corresponding electrical effects.

In the case of telephone transmitters, it is frequently desirable that these devices discriminate against unwanted sounds. For example, in a telephone exchange, the noise at neighboring operators' positions should not be picked up by a given operator's transmitter. It would be an advantage if the transmitter were small so that it could be supported with the receiver against the operator's ear, thereby obviating the need for the usual chest-supported, horn-type microphone.

In an acoustical wattmeter or impedance meter, a suitable microphone unit or pickup device is essential in order to measure the energy being carried by sound waves. To determine sound intensity in a free field, it is merely necessary to measure the sound pressure, but in the presence of reflected waves, the relation of the pressure and particle velocity components of the waves may be disturbed so that the pressure alone is no longer a reliable indication of the sound intensity. Under such conditions, the sound intensity can be determined only if the pressure and velocity components of the wave, as well as the phase angle between them, are taken into account. However, relatively large microphone units or pickups cause difficulties at high frequencies since the microphone size and spacing is comparable to the wave length. However, the tube type or probe microphone construction of the present invention permits the pickup units to be made small enough so that they disturb the wave very little. Also, the tube units can be mounted close together so that the sound energy can be derived from a very small region.

The various features and advantages of the invention will appear from the detailed description and claims when taken with the drawings in which:

Fig. 1 is a perspective view of one embodiment of the invention wherein there is provided a com-

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bined receiver and dipole microphone adapted to be worn as shown;

Fig. 2 is a side view and Fig. 3 is a rear view of the telephone combination illustrated in Fig. 1;

Fig. 4 is a plan view of a mouthpiece suitable for use in this embodiment;

Fig. 5 is a vertical section through this mouthpiece;

Fig. 6 is a sectional view thereof, taken on the line 6, 6 of Fig. 4;

Fig. 7 illustrates that portion of the microphone and the receiver which is mounted within the casing or shell, the shell being broken away to illustrate the arrangement of the parts therein;

Fig. 8 is a bottom view of the junction block assembled on the bottom of the yoke;

Fig. 9 is a bottom view of the yoke alone;

Fig. 10 is a section taken substantially on the line 10, 10 of Fig. 9 showing the relation of the passages through the junction block and through the passages in the yoke as well as the respective cavities at each surface of the diaphragm mounted within the capsule;

Fig. 11 is an enlarged view of the elements mounted within the shell, particularly illustrating the microphone element and the receiver with the shield mounted between these parts and providing a support for the receiver;

Fig. 12 is a front view of a portion of the shield alone with the receiver mounted thereon;

Fig. 13 is a face view of the microphone unit with the yoke mounted thereon;

Fig. 14 is a similar view of the reverse side of the microphone and yoke;

Fig. 15 is a perspective view and Fig. 16 is a cross section through a modified form of tubing for connecting the mouthpiece with the microphone unit;

Fig. 17 illustrates a construction whereby the effective length of a tube connecting the mouthpiece to the microphone unit, can be adjusted;

Fig. 18 is a diagram illustrating the field of response of one embodiment of the pick-up unit of this invention;

Fig. 19 illustrates, by the broken line, the response of a dipole microphone with the dipole ends of the tubes left open while the full line graph illustrates the response of the dipole microphone of the present invention when the dipole

ends of the tubes are terminated with acoustical resistances;

Fig. 20 is a chart illustrating by the dotted line, the response of the present dipole microphone alone, and the broken line curve represents the transmission characteristic of eight miles of #22 telephone cable, while representing by the full line curve, the overall response of the present dipole microphone plus the mentioned cable;

Fig. 21 illustrates, by the broken line curve, the response of a conventional horn type operator's transmitter, while by the full line, it illustrates the response of the mentioned horn type transmitter plus the transmission characteristics of eight miles of #22 cable;

Figs. 22 to 26 inclusive are diagrams useful in explaining the principles of the invention;

Fig. 27 is a diagram useful in explaining the directional characteristics of the present dipole invention when tubes of different lengths are incorporated therein;

Fig. 28 is a diagrammatic showing of one type of microphone unit made in accordance with the present invention and suitable for use in an acoustical wattmeter or impedance meter;

Fig. 29 is a block diagram of an acoustical wattmeter or impedance meter incorporating the microphone or transducer unit of Fig. 28;

Fig. 30 is a diagrammatic showing of another type of microphone pickup of the present invention, likewise suitable for use in an acoustical wattmeter or impedance meter;

Fig. 31 is a circuit network which will be substituted for that portion of the meter of Fig. 29 at the left of the broken line thereof when the microphone pickup of Fig. 30 is used.

One embodiment of the invention, in the form of a dipole microphone of the pressure gradient type, is shown incorporated in an operator's telephone set in Figs. 1 to 17 inclusive. This telephone set comprises a shell 1 in which a microphone unit generally designated 2 and a telephone receiver 3 are enclosed, the shell with its enclosed parts being of a size and weight to be supported against the ear of the operator by means of a band 4 engaging the operator's head. The microphone unit may be any type of electro-acoustic transducer including a carbon or piezo-electric system. As herein illustrated, the microphone unit 2, preferably of the electromagnetic type, comprises an electromagnetic element 5 and the microphone capsule 6 of aluminum alloy on which this element is mounted. This electromagnetic element includes a pair of spaced pole pieces 7, 7 secured to the respective sides of a rectangular permanent magnet 8, these parts being retained in the position illustrated in Fig. 14 by a suitable brass clamp 10 secured to the capsule. Each pole piece has a part encircled by a coil 9, the two coils 9 being electrically connected in series for inclusion in a transmitter circuit (not shown). The extensions 7a, 7a (Fig. 14) of the two pole pieces just project through a wall of the capsule being sealed therein against air leakage. Thus, the extensions 7a, 7a of the pole pieces are positioned close to one surface of a diaphragm 11 within the capsule so that the electromagnetic element is influenced by the action of the diaphragm. Although this diaphragm is shown to be clamped in Fig. 10, it can be unclamped. The diaphragm defines the cavities 12 and 13 at the respective sides thereof, which cavities are proportioned to give adequate damping of the diaphragm resonance peak and to prevent a nodal diameter mode of vibration as will be further discussed hereinafter. The cavities 12 and 13 communicate through the tubes 15 and 16 respectively, which terminate in the mouthpiece 17 to be held adjacent the operator's mouth so that the usual horn type microphone can be dispensed with. While the optimum internal diameters of the tubes 15 and 16 are related to the characteristics of diaphragm, in one model they measured nine-sixty fourths of an inch. The specific construction which affords communication between the cavity 12 and tube 15 on the one hand and between cavity 13 and tube 16 on the other, is shown in Figs. 7 to 10 inclusive and comprises a yoke 18 together with a connection block 19. The yoke (Fig. 10) is made with two hollow branches 20 and 21 respectively provided with openings 22 and 23 in their respective inner surfaces. The faces of the microphone capsule are milled out to provide recesses 24 having openings 25 and 26 into the cavities 12 and 13, the mentioned openings being preferably covered by dirt screens. Thus, the recesses in the microphone capsule can snugly receive the branches of the yoke with the openings 22 and 23 of the yoke respectively communicating with the openings 25 and 26 through the face walls of the capsule. The lower end of the yoke is provided with diagonally extending recesses 29 and 30 which communicate respectively with the hollow passages through the yoke branches. The connection block which can be assembled on the mentioned lower end of the yoke by suitable screws, has a pair of passages 32 and 33 extending therethrough to open into the recesses 29 and 30 respectively. By this construction, the pair of passages through the block which are arranged in one plane can communicate with the pair of yoke passages which are arranged in a plane extending at right angles to the first plane. The lower ends of these passages 32 and 33 are slightly enlarged to frictionally receive the upper ends of the tubes 15 and 16.

The dipole mouthpiece 17, as best shown in Figs. 4, 5 and 6 is preferably made of a block of light weight molded material having its ends 35a and 35b rounded, as illustrated. Each of the rounded ends of the mouthpiece is notched as at 36 and has an opening 37 in the notched part communicating with a passageway 38. Each passageway 38 is formed with a bend leading to an orifice 39 in one side of the block. It will be noted that the two orifices 39, 39 are located close together and may detachably receive the free ends of the tubes 15 and 16.

Each opening 37 from the passageway into the notched part of the mouthpiece is covered by a disc 40 of silk fabric secured at its margin by suitable adhesive to the surface of the mouthpiece. The weave of the silk should be such as to provide the proper acoustic terminal impedance for the tubes 15 and 16, the purpose of which will be hereinafter set forth. Each notched end of the mouthpiece carries two curved pieces 41 and 42 of screening, such as wire gauze, the outer screen 42 conforming generally to its related rounded end of the mouthpiece. As illustrated in Fig. 1, the dipole mouthpiece is worn close to the lips, although this position is not critical, and consequently, in the absence of these screens 41 and 42, there would be serious blasting noises in the microphone due to the puffs of air accompanying such sounds as "p" and "t." This double puff screen construction provides more effective reduction of puffing than a single screen and in addition enables the operator to remove and sterilize the outside screens without exposing the ter-

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minal resistances 40 to mechanical damage. Since the mouthpiece is intended to be worn with one end of the dipole relatively close to the lips and the other dipole end directed toward the chin, the tubes 15 and 16 are preferably made of some shape-retaining deformable material which may be, for example, a thermo-plastic material, such as that now known as "Saran," so that the tubes can be generally shaped to the contour of the operator's face whereby the mouthpiece will be properly located with respect to the operator's mouth when the telephone receiver is supported in contact with one of her ears, as shown.

Instead of using two separate tubes, such as 15 and 16, a single strip of relatively soft material 45 (Figs. 15 and 16) having two passages 46 and 47 therethrough may be used, when the openings in the yoke and in the mouthpiece are modified to receive the respective ends of the strip. In this modification, the strip has a wire 49 incorporated therein which tends to cause the strip to remain in the position to which it has been bent in the course of being adjusted to the head of an operator.

Under certain conditions it may be desirable to modify the directional characteristics of the microphone and for this purpose at least one of the tubes 15 and 16 may be arranged so that its effective length can be adjusted at will. For example, the tube 16' (Fig. 17) is provided with a telescoping crook 16'' similar to a tuning slide on a trumpet.

The telephone receiver 3 may be any light weight watch case receiver of small size. One flat side of the receiver is provided with an opening to allow room for the yoke 18 to be assembled on the capsule 6 when the microphone 2 and the receiver 3 are compactly arranged as shown with the microphone magnet 8 at right angles to the receiver magnet 48 and its related pole pieces. A magnetic shield 49a is mounted between the microphone and the receiver to prevent disturbing action therebetween. This shield also serves as a mechanical support for holding the receiver against the ear cap 1a of the shell.

A dipole microphone may be defined as one whose sound pickup elements are arranged in the form of an acoustic dipole, and are differentially associated with the transducer element. Such a microphone responds to a sound wave, only if there is a difference in pressure between the dipole ends 35a and 35b (Fig. 4). A sound originating in the plane midway between A and B, for example, would produce no pressure difference and, hence, no microphone response. The directional characteristics of the dipole microphone are shown in Fig. 18. When the microphone is worn as shown in Fig. 1, the plane of minimum response includes sounds originating at each side of the operator, and also sounds coming from in front of and somewhat below the operator's head. Thus the microphone can be oriented so as to discriminate against the voices of the adjacent operators and the clattering of plugs on the switchboard, and yet be in a position to give maximum response to the voice of its wearer.

Even in the direction of its maximum response, the dipole microphone discriminates against distant sounds—especially sounds of low frequency. This is of benefit in many locations where rumbling noises are troublesome. The explanation is as follows: when the microphone is worn with one end of the dipole close to the lips, sounds issuing from the wearer's mouth give rise to amplitude, as well as phase differences at the dipole ends. For sounds arriving from a distance, however, there is substantially no amplitude difference at the dipole ends. Consequently, the response in this latter case is due almost entirely to phase difference. As the wave length of the received sound becomes longer, the distance between the dipole ends constitutes a smaller and smaller proportion of the wave length. Thus, the phase difference becomes progressively smaller for lower frequencies. It is this fact which accounts for the discrimination mentioned above.

A further substantial gain in signal-to-room-noise ratio over the conventional breastplate transmitter is obtained because of the close location of the dipole to the lips. This location is fixed, whereas the corresponding relation in the case of the breastplate transmitter varies as to angle and distance with the movements of the wearer's head.

A still further advantage of the dipole microphone in noisy locations is its freedom from resonant peaks, as compared with strong resonances of the usual breastplate transmitter horn. These latter resonances are shock-excited by certain of the noise components, and the noise is effectively amplified in the process.

The use of tubes, such as 15 and 16, constitute an acoustic transmission line for the conduction of sound from the dipole mouthpiece to the microphone unit proper (located in the receiver case), makes it possible to eliminate the large horn traditionally associated with operator's sets. The inherent presence of standing waves in tubes 15 and 16 has, in the past, prevented the use of a microphone employing a small number of tubes where reasonably faithful reproduction was desired. In the present dipole microphone, however, a termination resistance 40 at the dipole end of each tube matches the acoustic impedance of the tube and eliminates the effect of the standing waves. Fig. 19 shows (solid line curve) the normal frequency response of this microphone and, for purposes of comparison, the response (dotted line curve) with the terminating resistance removed. It will be noted that the normal response of the microphone rises 6 db per octave toward the high frequencies. This type of response compensates for the drooping transmission characteristic of unloaded cable circuits. Fig. 20 shows the transmission characteristic of eight miles of No. 22 cable and the overall response of the cable and microphone. For comparison, Fig. 21 shows the response of the conventional horn type operator's set.

Fundamental theory

The principles of the invention will best be understood by reference to Figs. 17 to 22 together with the following analysis. The pressure at a distance r from a point source of sound can be expressed by

$$p=\frac{A\omega\rho}{r}\sin k(ct-r) \qquad (1)$$

where:

p=the sound pressure at the point in questions.

A=the amplitude of the velocity potential.

ρ=the density of the medium.

r=the distance from the point source to the point in question.

$\omega=2\pi f$, where f is the frequency.

c=velocity of sound in the medium.

t=time.

$k=2\pi/\lambda$, where λ=the wave length of the sound wave.

The difference in pressure between two points A and B separated by a distance D (Fig. 22) is given by the following expression:

$$\Delta p = A\omega\rho\left[\frac{\sin k(ct-r)}{r} - \frac{\sin k(ct-r-D)}{r+D}\right] \quad (2)$$

Two extreme conditions are of interest in practice. One is for sounds originating at a distance from the microphone; i. e., r is large compared to D. The other is for sounds originating very close to the microphone; i. e., r is small compared to D. Also, in general, D is small compared to the wave length, and kD is small compared to unity. If r is large and kD is small, Equation 2 becomes

$$\Delta p \doteq kD\frac{A\omega\rho}{r} \cos k\left(ct-r-\frac{D}{2}\right) \quad (3)$$

Equation 3 shows that for a sound arriving from a distance, $|\Delta p|$ is smaller than the pressure at A by a factor kD. If r is small compared to D, Equation 2 becomes

$$\Delta p \doteq \frac{A\omega\rho}{r} \sin k(ct-r) \quad (4)$$

A comparison between Equation 1 and Equation 4 shows that Δp is approximately the same as the pressure at point A. If, however, the sound source is located on the median plane between points A and B, there is no resultant difference in pressure between the two points.

A pressure gradient microphone close to the source

When a pressure gradient micrphone is used close to the source, it becomes an instrument which discriminates very powerfully against sounds arriving from a distance ("a distance" being merely a few feet for voice frequencies). The factors responsible for this discrimination can be summarized as follows:

1. For sound arriving from a distance, the pressure gradient (strictly a pressure increment) is smaller than the sound pressure by a factor kD—a reduction which is especially apparent at low frequencies.

2. Sound which appears to originate in a plane midway between points A and B (see Fig. 1 and Fig. 22) produces no difference in pressure between the points and no response in the microphone.

3. A sound close to the microphone will, inherently, produce a greater response than a sound which is far away.

Analysis and factors affecting the frequency response of the dipole microphone

The factors affecting the response of a dipole microphone will best be understood by reference to Figs. 23, 24 and 25. Fig. 23 is a diagrammatic representation of the acoustic elements and the diaphragm of a dipole microphone. Fig. 24 shows the analogous electrical circuit corresponding to Fig. 23; and Fig. 25 is a simplification of Fig. 24. A list of symbols pertaining to the above three figures is given below:

p_1=sound pressure at one end of the dipole.
p_2=sound pressure at the other end of the dipole.
L_1=acoustic inertance due to radiation from the end of one tube.
L_2=acoustic inertance due to radiation from the end of the other tube.
R_1=acoustic resistance due to radiation from the end of one tube.

R_2=acoustic resistance due to radiation from the end of the other tube.
R_3=acoustic resistance inserted to terminate one tube
R_4=acoustic resistance inserted to terminate the other tube.
Z_{01}=characteristic acoustic impedance of the first tube=$\rho c/s_1$.

Where:

ρ=density of the medium.
c=velocity of sound in the medium.
s_1=cross-sectional area of the first tube.
Z_{02}=characteristic acoustic impedance of the second tube=$\rho c/s_2$.

Where:

s_2=the cross-sectional area of the second tube.
C_1=acoustic compliance of the cavity on the first side of the diaphragm.
C_2=acoustic compliance of the cavity on the other side of the diaphragm.
L_d=mass of the diaphragm (in consistent units).
C_d=compliance of the diaphragm (in consistent units).
v_d=diaphragm velocity (in consistent units).
l_1=length of the first tube.
l_2=length of the second tube.

Any type of transducer may be used to convert the diaphragm motion into electrical energy, but for the purposes of analysis it will be assumed that the transducer is some sort of an electromagnetic element which generates an E. M. F. proportional to the diaphragm velocity (v_d). Although it would be possible to derive a general expression for v_d in terms of p_1 and p_2 and all the circuit constants, the inherent symmetry of the microphone and the relative magnitudes of the end effects compared to the characteristic impedance of the respective tubes make possible considerable simplification. In practice, $C_1=C_2$, $l_1=l_2$, $Z_{01}=Z_{02}=R_3=R_4$, $R_1=R_2$, and $L_1=L_2$. Also $|R_1+j\omega L_1| \ll Z_{01}$, so R_1 and L_1 can be neglected. It follows, then, that looking back toward the generator from either AA or BB, the tube being considered is, in effect, a transmission line excited from a source having an internal impedance equal to the characteristic impedance of the tube. The impedance looking back from AA or BB is also equal to the characteristic impedance of the tube. From Thevenin's theorem and Kirchhoff's laws it can be shown that the circuit of Fig. 25, insofar as v_d is concerned, is the equivalent of the circuit in Fig. 24.

$\Delta p'$ in Fig. 25 is the difference in the "open circuit pressures" at AA and BB in Fig. 8. Z_0 is used instead of either Z_{01} or Z_{02} since the two are equal. If losses in the transmission tubes are neglected, it can be shown, from transmission line theory, that

$$\Delta p' = \frac{-j\Delta p}{\sin kl_1 - j\cos kl_1} \quad (5)$$

where Δp is the difference in pressure between p_1 and p_2. It will be noted that

$$|\Delta p| = |\Delta p'|$$

and the only effect of the tubes is to introduce a phase shift. If the ends of the tubes had been left open and R_3 and R_4 eliminated the tube impedance viewed from AA or BB would be either inductively or capacitatively reactive, and $\Delta p'$ would show sharp resonance peaks.

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Patented Nov. 14, 1950

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From Fig. 25 and Kirchhoff's laws:

$$v_d=\frac{\Delta p\frac{1}{j\omega C_1}}{\left(j\omega L_d+\frac{1}{j\omega C_d}\right)\left(Z_0+\frac{1}{j\omega C_1}\right)+\frac{2Z_0}{j\omega C_1}}\;\frac{-j}{\sin kl_1-j\cos kl_1} \qquad (6)$$

For low frequencies such that

$$\frac{1}{j\omega C_1}\gg Z_0 \text{ and } \frac{1}{j\omega C_d}\gg Z_0$$

$$|v_d| \doteq \Delta p\omega C_d \qquad (7)$$

That is to say, the diaphragm velocity is independent of Z_0 and C_1. If Δp is constant, v_d is proportional to the frequency. Equations 4 and 3 show that, close to the source, Δp is approximately the same as the pressure while at a distance from the source Δp is proportional to k and rises directly with the frequency. Close to the source, then

$$v_d \propto \omega p \qquad (8)$$

And at a distance

$$v_d \propto \omega^2 p \qquad (9)$$

At higher frequencies the total "current" through the tubes is limited by $2Z_0$, but the possible existence of resonance involving $C_1/2$, L_d, C_d may allow v_d to rise to a far higher value than the total "current" through the tubes. If C_1 is so small it can be neglected, and the frequency is such that the diaphragm impedance is small compared to $2Z_0$,

$$|v_d| \doteq \Delta p/2Z_0 \qquad (10)$$

and is independent of both C_d and C_1.

Close to the source

$$v_d \propto p \qquad (11)$$

And at a distance

$$v_d \propto \omega p \qquad (12)$$

When C_1 is small, the diaphragm velocity is limited by $2Z_0$ even at diaphragm resonance. Hence, the diaphragm resonance peak may be controlled by adjusting C_1. If C_1 is large enough that it is significant and the diaphragm resonance is so high that L_d is not significant,

$$|v_d| \doteq \frac{\Delta p}{Z_0\left(\frac{C_1}{C_d}+2\right)} \qquad (13)$$

which shows that v_d may depend upon the ratio of C_1 to C_d, as well as, the value of Z_0.

At frequencies above diaphragm resonance it is more difficult to predict the performance of the microphone, since instead of vibrating as a whole the diaphragm tends to vibrate in sections. It is possible, however, to control the mode of vibration of the diaphragm, to some extent, by adjusting the size and shape of C_1. The first mode of vibration above the fundamental occurs when the diaphragm vibrates with one nodal diameter, as shown in Fig. 26.

If the cavities on each side of the diaphragm are shallow, the air is pumped back and forth in the cavities in a manner similar to pumping air through slits. The shallow cavities present considerable resistance to the flow of air. It is possible, in practice, to make the cavities sufficiently shallow to suppress, by the coupled acoustic resistance, the one nodal diameter mode of vibration entirely.

As referred to above, in the case of plane waves, the directional characteristics of the normal dipole microphone show the "figure 8" shape like all pressure gradient microphones. The pattern can be changed to a cardioid shape (Fig. 27) or any shape intermediate the two as shown on page 210 in "Elements of Acoustical Engineering," published by D. Van Nostrand Co., Inc. This change can be effected by altering the length of one tube with respect to the other. If one tube is longer than the other by a length equal to the distance between the ends of the dipole, the directional pattern will be a cardioid provided losses in the tubes can be ignored. Strictly speaking, the cardioid pattern is obtained only with sounds originating at a distance from the microphone. For sounds originating close to the microphone there is a difference in pressure amplitude between the two ends of the dipole which prevents complete cancellation in the minimum response direction. If, however, the sensitivity of one side of the microphone is altered (by increasing the losses in one of the tubes), it is possible to make a microphone with zero response for sounds arriving from a definite direction and distance. Consider a dipole microphone in which the absolute ratio of sound pressure at the ends of the dipole must be

$$|p_1/p_2|$$

for the pressure on each side of the diaphragm to be equal. Let us suppose, also, that the sound source is located on a line connecting the two ends of the dipole, and that the lengths of the tubes are such that the pressures on both sides of the diaphragm are in phase. Under the assumed conditions, there would be no response to the sound wave. To find the distance from the sound source to the microphone for complete cancellation to take place, let us write:

$$p \propto {}^{1}/_{r}\, S_0$$

From Equation 1

$$p_1/p_2=r/(r+D)$$
$$r=D/(p_2/p_1-1) \qquad (14)$$

It is possible, then, to construct a microphone which will not respond to sounds originating at a certain spot. A similar adjustment of the sensitivity of either side of the microphone can be applied when the microphone is adjusted for directional patterns between "figure 8" and cardiod, but not when the pattern is a normal "figure 8."

Other modifications of the invention

While the invention has been disclosed above as a double tube or dipole microphone, it can be adapted to a single tube microphone by omitting the mouthpiece 17 and either one of the tubes 15 or 16 (Fig. 3). It will be understood, of course, that the retained tube, such as 16, will have its free end treated with a suitable terminal resistance which may be silk fabric, such as 40 (Fig. 6), or which may be a tuft of cotton or the like inserted therein and that the acoustic impedance associated with the other side of the diaphragm will be made suitably low preferably by increasing the size of the cavity back of the diaphragm. Such a microphone may be used in a combined telephone set similar to that of Fig. 1 when the noise-cancelling feature is not necessary.

The single tube unit which functions as a pressure microphone may also be combined with

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the auditory canal shown in fully expanded position,

relation is such that, when the receiver is applied

a pressure gradient microphone to provide a combination pressure and velocity responsive pick-up device (Fig. 28) for use in an acoustical wattmeter or in an impedance meter. While this pickup device is shown diagrammatically, the pressure gradient microphone portion thereof, with the exception of the mouthpiece, may be identical with the microphone illustrated in Figs. 1 to 16 inclusive and corresponding parts are designated by the same reference characters with the letter "a" added thereto. The free ends of the tubes 15a and 16a are each provided with a suitable terminal acoustic resistance designated 53. The pressure microphone comprises the microphone element 2b, which may be similar to that described, communicates with the tube 16b provided at its free end with a suitable terminal resistance such as an insert of cotton 54 or it may be in the form of a silk fabric covering, such as previously mentioned. The free ends of the tubes 15a, 16a and 16b which serve as probe tubes are arranged close together with the end of probe tube 16b located between the other two.

As long as the distance between points X and Z at the free ends of the dipole tubes is small compared to the wave length of sound being measured, the pressure difference between X and Z is proportional, both in phase and amplitude, to the particle velocity at a third point Y between the first two. If the pressure is also measured at Y, we have enough information to obtain either the specific acoustic impedance which is the complex ratio of pressure divided by the particle velocity, or the acoustic power passing the ends of the probe tubes, which is the real part of the complex product of pressure and particle velocity.

The pressure gradient microphone, then, gives a voltage which is proportional in amplitude to the particle velocity of the sound wave, while the pressure microphone gives a voltage which is proportional in amplitude to the pressure. If the total phase shift from the ends of the dipole tubes to the output terminals of the pressure gradient microphone is the same as the total phase shift from the end of the single tube to the output terminals of the pressure microphone, the phase difference between the two voltages is the same as the phase difference between the particle velocity and the pressure components of the sound wave. When the two voltages, just mentioned, have been thus developed, they can be introduced into appropriate electronic circuits and the complete assembly may be referred to as an acoustical wattmeter or impedance meter to give either the power or the impedance.

The acoustical wattmeter or impedance meter may be somewhat similar to that disclosed by Clapp and Firestone in the Journal of the Acoustical Society of America, issue of October, 1941, pages 125 and 126. In Fig. 29, there is shown a simplified block diagram of such a meter. In this diagram, the output of the velocity microphone 2a is connected to an alternating current amplifier and attenuator unit 56. The output of this unit is coupled to a phase corrector 57 which in turn is coupled to a thermocouple wattmeter 58. The output of the pressure microphone 2b of the pickup shown in Fig. 28 is likewise connected to an alternating current amplifier and attenuator unit 59. The output of this unit is coupled to a phase corrector 60 which in turn is also linked to the thermocouple wattmeter 58. The output of this thermocouple is delivered to an output galvanometer 61 which is calibrated in

watts per square centimeter of sound power passing the pickup. It should be pointed out that if the microphone units 2a and 2b are suitably matched, the phase correctors 57 and 60, can be omitted.

Another form of pickup device for use in an acoustical impedance meter or wattmeter, is illustrated in Fig. 30 wherein two pressure microphones, each having the parts 2b, 16b and 54, are mounted to have the free ends of the probe tubes 16b close together. With the pickup device just described, the pressure can be measured by taking the complex sum of the voltages from the two microphones 2b and the pressure gradient (or velocity) can be measured by taking the difference between these voltages.

The pickup device, comprising the microphones 2b, 2b (Fig. 30), can be utilized in [illegible]e meter of Fig. 29, when the bridge network [illegible] together with the pair of vacuum tubes 66 a[illegible] 67 of Fig. 31, are substituted for the portion of the diagram at the left of the broken line in Fig. 29. The vacuum tubes 66 and 67 can be dispensed with, if the input impedance to amplifiers 56 and 59 (Fig. 29) is high.

What we claim is:

1. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber, an electrical element influenced by said diaphragm, a tube of substantial length for conveying sound pressure to said chamber and communicating at one end with said chamber, the other end of said tube being disposed for picking up sounds to be communicated to said diaphragm, and means only at said other end of said tube for substantially eliminating the effect of standing waves therein.

2. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber, an electrical element influenced by said diaphragm, a tube of substantial length for conveying sound pressure to said chamber and communicating at one end with said chamber, the other end of said tube being disposed for picking up sounds to be communicated to said diaphragm, means only at said other end of said tube for substantially eliminating the effect of standing waves in said tube, and a puff screen covering the other end of said tube.

3. In a telephone set, a microphone adapted to be supported adjacent the ear of the user, and a tube adapted to extend from the microphone to a point adjacent the mouth of the user whereby sound is conveyed to the microphone, the end of said tube adjacent the mouth of the user being provided with means for substantially eliminating the effect of standing waves therein.

4. In a telephone set, a microphone adapted to be supported adjacent the ear of the user, a tube of a length to extend from the microphone to a point adjacent the mouth of the user whereby sound is conveyed to the microphone, the end portion of the tube adjacent the mouth of the user having means thereat for substantially eliminating the effect of standing waves in said tube, and a puff screen substantially covering the last-mentioned end of said tube.

5. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means provided with only a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and

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one end of the other passage communicating with the other chamber, the distance between the remaining ends of said passages being small compared to the wavelength of the desired sounds to be received and disposed for picking up sounds to be communicated to said diaphragm, and means only at said remaining ends for substantially eliminating the effect of standing waves in said passages.

6. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means provided with only a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and one end of the other passage communicating with the other chamber, the distance between the remaining ends of said passages being small compared to the wavelength of the desired sounds to be received and disposed for picking up sounds to be communicated to said diaphragm, means only at said remaining ends for substantially eliminating the effect of standing waves in said passages and puff screens covering the last-mentioned ends of said passages.

7. In a combined transmitter and receiver unit adapted to be supported adjacent the ear of the user, a case, a microphone element and a receiver element mounted therein, a magnetic shield positioned between said elements, each of said elements having means developing a magnetic field, the magnetic means of one element being positioned at substantially right angles to that of the other, the microphone element comprising a capsule, a diaphragm cooperating with said capsule to define a chamber at each side of said diaphragm, said diaphragm serving to influence the electrical means of said microphone, and means having long slender passages respectively communicating with said chambers and adapted to terminate at spaced points adjacent the mouth of the user.

8. In a combined transmitter and receiver unit adapted to be supported adjacent the ear of the user, a case, a microphone element and a receiver element mounted therein, a magnetic shield positioned between said elements, each of said elements having means developing a magnetic field, the magnetic means of one element being positioned at substantially right angles to that of the other, the microphone element comprising a capsule, a diaphragm cooperating with said capsule to define a chamber at each side of said diaphragm, said diaphragm serving to influence the electrical means of said microphone, means having long slender passages respectively communicating with said chambers and adapted to terminate at spaced points adjacent the mouth of the user, and means substantially eliminating the effect of standing waves in said passages.

9. In a combined transmitter and receiver unit adapted to be supported adjacent the ear of the user, a case, a microphone element and a receiver element mounted therein, a magnetic shield positioned between said elements, each of said elements having means developing a magnetic field, the magnetic means of one element being positioned at substantially right angles to that of the other, the microphone element comprising a capsule, a diaphragm cooperating with said capsule to define a chamber at each side of said diaphragm, said diaphragm serving to influence the electrical means of said microphone, means having long slender passages communicating with said chambers and adapted to have their free ends terminate at spaced points adjacent the mouth of the user, means substantially eliminating the effect of standing waves in said passages, and puff screening covering the free ends of said passages.

10. In a combined transmitter and receiver unit adapted to be supported adjacent the ear of the user, a case having a microphone element and a receiver element mounted therein, a magnetic shield positioned between said elements, each of said elements having means developing a magnetic field, the magnetic means of one element being positioned at substantially right angles to that of the other, the microphone element comprising a capsule, a diaphragm cooperating with said capsule to define a chamber, said diaphragm serving to influence the electrical means of said microphone, and a tube having a long slender passage communicating with said chamber and adapted to terminate at a point adjacent the mouth of the user, said tube being made of a material adapting it to be shaped to the face of the user.

11. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, a pair of tubes having two of their ends respectively communicating with said chambers, means for changing the effective length of at least one of said tubes, the other end of said tube being disposed for picking up sounds to be communicated to said diaphragm, and means only at said other ends of said tubes for substantially eliminating the effect of standing waves in said tubes.

12. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means provided with a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and one end of the other passage communicating with the other chamber, and a mouthpiece comprising an elongated block having a pair of side openings therein respectively communicating with the remaining ends of said passages, said side openings respectively communicating with an opening in each end of said block, said block being supported during use with one end opening therein directed toward the wearer's mouth and the other end opening therein being directed away from wearer's mouth.

13. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means provided with a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and one end of the other passage communicating with the other chamber, a mouthpiece comprising an elongated block having a pair of side openings therein respectively communicating with the remaining ends of said passages, said side openings respectively communicating with an opening in each end of said block, said block being supported during use with one end opening therein directed toward the wearer's mouth and the other end opening therein being directed away from wearer's mouth, and pieces of porous material, such as silk, providing acoustical impedance at said end openings.

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adapted to be mounted on the casing over the

is angularly related to the axis of said diaphragm

14. In a sound pick-up device, a microphone comprising a hollow capsule divided by a diaphragm into two chambers, electrical means arranged to be influenced by said diaphragm, tubular means having two passages respectively communicating at one end with said chambers, said tubular means having the free end thereof terminating at a position remote from said chambers with the free ends of said passages spaced a small distance apart compared to the wavelength of the desired sound being measured, and a second microphone comprising a diaphragm and electrical means to be influenced thereby, a tube having one end communicating with said last-mentioned diaphragm and having its other or free end terminating between the free ends of said passages, means for substantially eliminating the effect of standing waves in said tube and in said passages, and means for combining the responses of said microphones.

15. In a sound pick-up device, a pair of microphones each provided with a probe-like tube to communicate sound effects to its respective microphone, the exposed ends of said tubes terminating close together, means only at said exposed ends for substantiailly eliminating the effect of standing waves in said tubes and means for combining the responses of said microphones.

16. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means providing a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and the other passage communicating at one end thereof with the other of said chambers, the distance between the other ends of said passages being small compared to the wavelength of the desired sounds to be received, means for varying the length of one of said passages, and means only at said other ends of said tubes for substantially eliminating the effect of standing waves in said passages.

17. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means providing a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and one end of the other passage communicating with the other chamber, the distance between the other ends of said passages being small compared to the wavelength of the desired sounds to be received, one of said passages being longer than the other of said passages by a length equal to the spacing between said other ends of said passages, and means only at said other ends of said tubes for substantially eliminating the effect of standing waves in said passages.

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WILLARD P. MEEKER.

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THE JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA VOLUME 16, NUMBER 3 JANUARY, 1945

The Dipole Microphone

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A DIPOLE microphone is a microphone in which the response is a function of the sound pressure at two distinct points. In the particular model to be discussed in this paper, the sound pressure at each of the two selected points is transmitted through tubes to opposite sides of the microphone diaphragm. The use of tubes makes it possible to remove the microphone transducer element from a location directly in front of the talker's mouth, and yet retain the acoustical advantage of a close-talking microphone. Figure 1 shows the dipole microphone as a part of a telephone operator's set, and Fig. 2 shows an exploded view of the same set.

FIG. 1. The dipole microphone set.

The capsule containing the microphone diaphragm and the electromagnetic transducer is mounted in the same case with the telephone receiver. By careful construction it has been possible to eliminate any trouble caused by coupling between the receiver and microphone. The transparent plastic mouthpiece at the free ends of the sound conducting tubes is called the

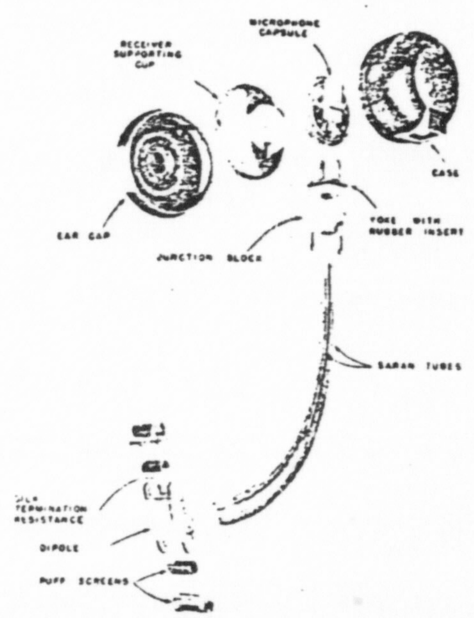

FIG. 2. Exploded view of the dipole microphone set.

dipole, although acoustically speaking, the term "dipole" should refer only to the configuration constituted by the two tube openings at the top and bottom of the plastic mouthpiece. A disk of silk cloth, which forms an acoustic resistance, covers each of the two dipole openings. The silk disks eliminate the peaks in the response [illegible] caused by standing waves in the tubes. Two puff screens of fine mesh wire screen cover each end of the dipole. When the dipole is used [illegible] to the mouth, these puff screens are ne[illegible]sary [illegible] reduce the blasting noises accompany[illegible] explosive sounds as "p" and "t."

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ANALYSIS

To analyze the performance of such a microphone, let us consider the analogous electric circuit shown in Fig. 3 where: p_1 = sound pressure

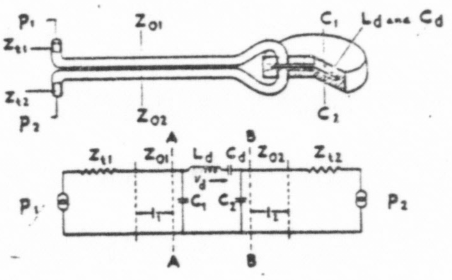

FIG. 3. Schematic diagram of the acoustical system and an analogous electrical circuit.

at one end of the dipole, p_2 = sound pressure at the other end of the dipole, Z_{t1} = acoustic impedance terminating the first tube, including the radiation impedance, Z_{t2} = acoustic impedance terminating the second tube, including the radiation impedance, Z_{01} = characteristic acoustic impedance of the first tube, Z_{02} = characteristic acoustic impedance of the second tube, $\gamma_1 = \alpha_1 + j\beta_1$ = propagation constant of the first tube, $\gamma_2 = \alpha_2 + j\beta_2$ = propagation constant of the second tube, l_1 = length of the first tube, l_2 = length of the second tube, C_1 = acoustic compliance of the cavity on one side of the diaphragm, C_2 = acoustic compliance of the cavity on the other side of the diaphragm, L_d = acoustic inertance of the diaphragm, C_d = acoustic compliance of the diaphragm, v_d = volume velocity of the diaphragm. As this circuit can be treated by fairly straightforward analysis, the method will merely be sketched and the results given. If we enter the circuit at the line A–A we can, by using Thevenin's theorem, replace all of the circuit elements to the left of A–A by an equivalent generator having a certain open circuit voltage and a certain internal impedance. This internal impedance can be expressed by:

$$Z_{AA} = Z_{01} \tanh(\gamma_1 l_1 + \gamma_{t1}), \qquad (1)$$

where

$$\gamma_{t1} = \tanh^{-1} \frac{Z_{t1}}{Z_{01}}.$$

If $Z_{t1} = Z_{01}$, $\gamma_{t1} = \infty$, and Eq. (1) reduces to

$$Z_{AA} = Z_{01}. \qquad (2)$$

In other words, the internal impedance of the equivalent generator is that of a transmission line terminated in its own characteristic impedance, and is, of course, substantially resistive and independent of frequency. The open circuit voltage at A–A, or, if we refer to the acoustical diagram, the blocked tube pressure at the cavity end of the top tube, is expressed by

$$p_{AA} = p_1 \frac{\cosh \gamma_{t1}}{\cosh(\gamma_{t1} + \gamma_1 l_1)}. \qquad (3)$$

Now, if we still assume that $Z_{t1} = Z_{01}$ we can rewrite Eq. (3) in the exponential form,

$$p_{AA} = p_1 \exp(-\gamma_1 l_1)$$
$$= p_1 \exp(-\alpha_1 l_1) \exp(-j\beta_1 l_1). \qquad (4)$$

From Eq. (4) it is evident that, if the attenuation in the tube is small, as it is in the practical microphone, the major effect of the tube is the introduction of a phase shift and not a change in amplitude. Since the equivalent generator has a resistive internal impedance and an open circuit voltage which are both substantially independent of frequency, there are no resonance peaks introduced by the tube.

The right side of the microphone may be treated similarly, and another equivalent generator substituted for all of the circuit elements to the right of the line B–B. If the microphone be assumed perfectly symmetrical, if attenuation be neglected, and if the termination impedances match the characteristic impedances of the tubes, a much simpler circuit can be drawn as shown in Fig. 4, where $\Delta p' = (p_1 - p_2)\epsilon^{-j\beta l}$. That is, as far

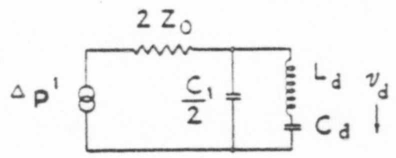

FIG. 4. Simplified equivalent circuit.

as amplitude is concerned, $\Delta p'$ is equal to the

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complex difference in pressure between the two ends of the dipole.

Since not all of the assumptions made in the simplified circuit are true for the practical microphone, the simplified circuit cannot be used for rigorous analysis. It can be used, however, to show the effect of the tubes on the sensitivity of the microphone. Since the tubes are fairly small, a little over $\frac{1}{4}''$ I.D., one might suppose the use of larger tubes would increase the sensitivity. If $2Z_0$ is small compared to the parallel impedance of $C_1/2$, L_d and C_d, the velocity through L_d and C_d becomes substantially independent of both Z_0 and C_1. In the practical microphone $2Z_0$ is small compared to the parallel circuit impedance over most of the voice frequency range. Hence, there would be no particular gain in sensitivity if the tubes were larger. At diaphragm resonance, however, the impedance in the L_d, C_d branch is very low and the diaphragm velocity is controlled by the value of Z_0. Thus by the proper choice of circuit constants it is possible to control the relative height of the diaphragm resonance peak.

FREQUENCY RESPONSE

To calculate the frequency response of the microphone, it was necessary to use the first analogous circuit (Fig. 3) since in the model considered, the cavities on either side of the diaphragm did not have the same volume. The calculations for the dashed curve in Fig. 5 were

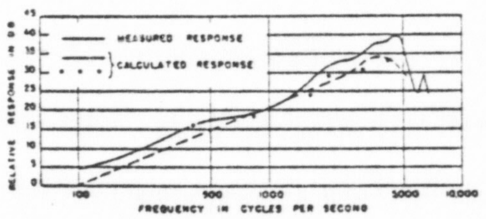

FIG. 5. Comparison of measured and calculated response of the dipole microphone.

based on the assumptions that attenuation could be neglected, that the dipole impedance matched the tube impedance, that p_2 was equal to zero, and that p_1 was constant and independent of frequency. Later in this paper, we shall investigate the pressure at the ends of the dipole more thoroughly. Since the microphone transducer was a magnetic diaphragm type unit, its open-circuit voltage was assumed to be proportional to the diaphragm velocity. The individual points were calculated after taking into account the effect of attenuation[1] on the characteristic impedance of the tube and on the propagation constant. We also used the measured value of the dipole impedance instead of assuming that it matched the tube impedance exactly. The solid curve represents the measured frequency response. The measured curve shows greater high frequency response than the calculations predicted. Unfortunately, there has been no opportunity to investigate the reasons for this discrepancy. Notice, however, that a curve following the calculated points departs from a straight line at about the same frequencies as the measured curve, and the variations are of the same order of magnitude.

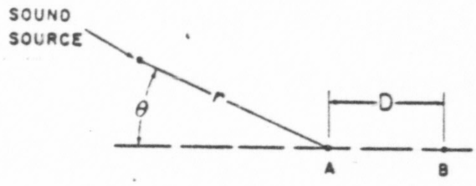

FIG. 6. Schematic representation of a sound source and a dipole microphone.

NOISE REDUCTION

Now let us examine the pressure at each end of the dipole a little more closely. Figure 6 shows a source of sound which for simplicity we can assume to be a point source. Of course, such an assumption means we are neglecting diffraction about the wearer's head, but it will serve as a start. At a distance r from the source is located one end of the dipole A. The other end of the dipole is located at B. Since the symmetrical microphone responds to the difference in pressure between the two ends of the dipole, let us work out an expression for the difference in pressure between A and B.

[1] W. P. Mason, *Electromechanical Transducers and Wave Filters* (D. Van Nostrand Company, Inc., New York, 1942), p. 118.

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We can express the pressure at A by

$$p_A = \frac{p}{r}\sin k(ct-r), \tag{5}$$

where p = sound pressure produced by the source at a unit distance, $k=\omega/c$, $\omega=2\pi f$, c = velocity of sound. If θ is small or r is large compared to D, the pressure at B can be expressed by

$$p_B = \frac{p}{r+D\cos\theta}\sin k(ct-r-D\cos\theta). \tag{6}$$

To obtain the difference in pressure, it is necessary merely to subtract Eq. (6) from Eq. (5). Then

$$\Delta p = \frac{p}{r}\sin k(ct-r) - \frac{p}{r+D\cos\theta} \times \sin k(ct-r-D\cos\theta). \tag{7}$$

Two extreme conditions are of interest in practice. One applies when the sound source is very close to one end of the dipole and the other, when the source is a long distance away. For close-up use, r is small compared to D and Eq. (7) becomes

$$\Delta p \cong p/r \sin k(ct-r). \tag{8}$$

That is, the pressure difference between the ends of the dipole is substantially equal to the pressure at A, and the pressure at B can be neglected. The measured frequency response shown in Fig. 5 was obtained by placing one end of the dipole so close to the sound source that Eq. (8) was applicable. For distant sounds, r is large compared to D and Eq. (7) becomes

$$\Delta p \cong 2\sin\frac{kD\cos\theta}{2}\,\frac{p}{r}\cos k\left(ct-r-\frac{D}{2}\cos\theta\right). \tag{9}$$

If we compare Eqs. (5) and (9) we can see that, as far as amplitude is concerned, the difference in pressure for distant sounds is equal to the pressure at one end of the dipole multiplied by the term $2\sin[(kD\cos\theta)/2]$. Since this term becomes progressively smaller for low frequencies, it is apparent that the dipole microphone discriminates against low frequency sounds arriving from a distance. Also, since if $\theta=\pi/2$, $\cos\theta=0$, the microphone does not respond to sounds arriving from a direction perpendicular to the line connecting the two ends of the dipole. In the operator's set, the dipole is so oriented that the voices of the adjacent operators, and also the sound of the clattering plugs, arrive approximately from the direction of minimum response. For frequencies low enough that $\sin kD \cong kD$, the dipole microphone shows the familiar cosine directional characteristics which are inherent in any pressure gradient microphone. The measured directional characteristics of an early experimental dipole microphone are shown in Fig. 7.

Two effects, then, the directional characteristics and the loss of low frequency sensitivity with distance, tend to discriminate against sounds which do not originate close to one end of the dipole. In order to obtain some figure which represents the total discrimination of the microphone against all distant sounds, we can integrate the energy which the dipole microphone would receive from all directions; do the same thing for a non-directional pressure microphone; then compare the results. To make this comparison, it must be assumed, of course, that the two types of microphones have the same close-up sensi-

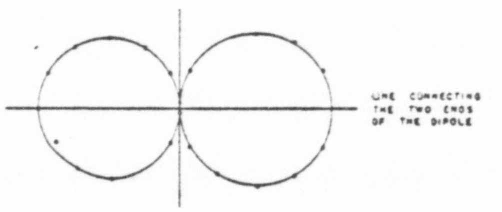

FIG. 7. Directional characteristics of an experimental dipole microphone measured at 1000 c.p.s.

tivity. An expression analogous to this comparison has been worked out for radio broadcast type microphones several times before,[2] and has been called the random energy efficiency. The random energy efficiency is given by the expression:

$$\text{R.E.} = \tfrac{1}{2}\int_0^{\pi} f^2(\theta)\sin\theta\, d\theta, \tag{10}$$

[2] W. P. Mason and R. N. Marshall, J. Acous. Soc. Am. 10, 214–215 (1938), Appendix A. Benjamin Baumzweiger, J. Acous. Soc. Am. 11, 477–479 (1940).

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where $f(\theta)$ is the directivity of the microphone expressed as a function of a plane angle θ. For conventional microphones, $f(\theta)$ is defined in terms of the maximum response of the microphone to plane waves; but since the dipole microphone is intended to discriminate against plane waves, we must redefine $f(\theta)$ in terms of the close-up response of the dipole microphone. For the dipole microphone

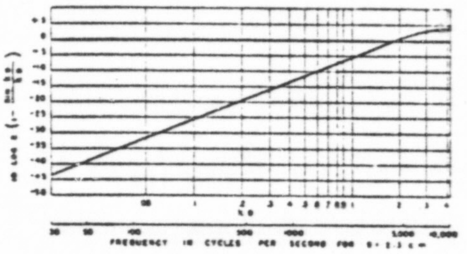

FIG. 8. Random energy efficiency of a close talking dipole microphone.

$$f(\theta) = 2 \sin \frac{kD \cos \theta}{2}, \tag{11}$$

and

$$\text{R.E.} = 2\left(1 - \frac{\sin kD}{kD}\right). \tag{12}$$

For small values of kD, Eq. (12) reduces to

$$\text{R.E.} = \frac{(kD)^2}{3}. \tag{13}$$

Equations (12) and (13), then, represent the ratio of the random energy picked up by an ideal dipole microphone in a free field to the energy picked up by a non-directional pressure microphone, provided the two microphones have the same close-up sensitivity. Equation (12) is plotted in terms of db in Fig. 8. For $kD \leqq 1.9$, there is no discrimination against distant sounds. If the dipole spacing is 2.3 cm, the corresponding frequency would be 4500 c.p.s.

Since a completely analytical approach to a problem is likely to involve some rather dubious assumptions, an experimental check of the noise discriminating properties of the dipole microphone seemed desirable. There was some conflicting philosophy as to just what our experiments were intended to measure. That is, were we trying to compare the performance of microphones which might have widely differing frequency characteristics, and which were intended to be used at a variety of distances from the mouth? Or, were we to isolate the effect of using a dipole pick-up device? Both the construction of the dipole microphone and the form the analysis had taken led us to adopt the second point of view. To convert the dipole microphone into a non-directional pressure microphone, it was necessary merely to substitute for one of the original tubes another tube of the same diameter which was long enough to be acoustically "infinite." Such a change would affect neither the close-up sensitivity nor the frequency response, so we decided to measure the response of both the normal and converted microphones in a random noise field.

The microphone to be tested was set up in a large irregular concrete room which had a reverberation time of about 13 seconds. Amplified thermal noise reproduced by a loudspeaker was used to supply the random noise, and the output of the microphone was measured over a series of octave bands. The loudspeaker and microphone were oriented so that, as far as the horiontal plane was concerned, there were no detectable directional effects at the microphone position. To check the possibility of noise entering the microphone through the walls of the infinite tube, two infinite tubes were substituted for the dipole. The output of the microphone with the two infinite tubes was recorded as "leakage."

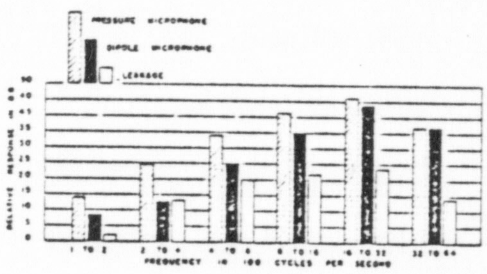

FIG. 9. Ambient noise response for dipole and pressure microphones.

Further checks seemed to indicate that most of the "leakage" noise was reaching the microphone diaphragm through the case walls rather than through the tube walls. Figure 9 shows the

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results of the noise discrimination measurements. There is, in general, a trend toward a greater degree of discrimination for low frequencies, though the discrimination is not so great as that predicted analytically. The 3200–6400 c.p.s. band shows no discrimination at all, which agrees pretty well with the zero discrimination frequency of 4500 c.p.s. calculated for this same model.

Since the noise discrimination measurement was carried out under free field conditions, there is a legitimate objection that the test conditions were not representative of the conditions existing in actual use. Diffraction around the wearer's head had been ignored in the analysis; so as to evaluate tentatively the effects of diffraction, the experiment described above was repeated with a person wearing the microphone in the manner shown in Fig. 1. Although diffraction effects were noticeable, they were never more than one or two db.

In the foregoing analysis, we have assumed that the dipole was located very close to the source of the desired sound. It is a matter of practical interest, however, to determine the loss in effective sensitivity when the dipole is so far from the source that we can no longer neglect the pressure at one of its ends. If r is on the same order of magnitude as D, neither Eq. (8) nor Eq. (9) is applicable. Let us look once more at Fig. 6. If $\theta=0$ we can divide the absolute value of Δp from Eq. (7) by the absolute value of p_A from Eq. (5) and obtain, eventually, an expression which represents an effective loss in sensitivity.

From (5) and (7) if $\theta=0$,

$$\frac{|\Delta p|}{|p|}=\left[1-\frac{2r/D}{r/D+1}\cos kD+\left(\frac{r/D}{r/D+1}\right)^2\right]^{\frac{1}{2}}. \quad (14)$$

Figure 10 shows Eq. (14) plotted in terms of db for several values of kD and for r/D as the independent variable. If, for example, the dipole should be so far from the source that $r/D=0.5$, the effective loss in sensitivity would be about 3.5 db for most of the voice frequency range. Of course, the loss is greater for low frequencies than for high.

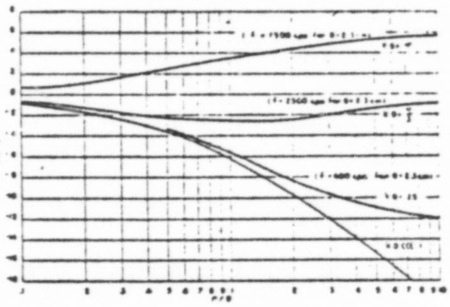

Fig. 10. Relative sensitivity as a function of the distance from the source and of the dipole spacing.

OTHER APPLICATIONS

So far we have mentioned only one application of the dipole microphone employing sound transmission tubes. If it should be desirable, for example in a distant talking microphone, the directional characteristics could be changed from the cosine type to cardioid by changing the length of one tube by an amount equal to the dipole spacing.[3] It might even be possible to construct a microphone in which one tube had an adjustable crook, like a trumpet tuning slide, and thus obtain a variety of directional patterns.

The small size of the tubes which can be used suggests the additional possibility of applying some form of tube microphone to an acoustic wattmeter, or an impedance measuring device, where it is desirable to make measurements without disturbing the sound field. The velocity component could be measured with some form of the dipole microphone, while the pressure measuring element could be a single-tube microphone with the open end of the tube terminated in the appropriate resistance.

[3] H. F. Olson, *Elements of Acoustical Engineering* (D. Van Nostrand Company, Inc., New York, 1940), p. 210.

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Program of the Twenty-Ninth Meeting of the Acoustical Society of America

HOTEL PENNSYLVANIA, NEW YORK, NEW YORK

May 12–13, 1944

1. The Physics of Hearing Measurements. JOHN C. STEINBERG, *Bell Telephone Laboratories.*—This paper discusses some of the physical considerations involved in the measurement and correction of hearing impairment, and briefly reviews work which has been done in the past.

2. Articulation Tests for Hearing Aids. HALLOWELL DAVIS, *Harvard University.*

3. Methods of Testing the Electrical and Acoustical Properties of Hearing Aids. RUDOLPH NICHOLS, *Harvard University.*

4. Anatomical Changes Responsible for Blast Deafness and the Prevention of Such Damage to the Ear. STACEY R. GUILD, M.D., *Otological Laboratory, The Johns Hopkins Hospital.*

5. The Army Aural Rehabilitation Program. M. R. MOBLEY, *Lt. Col. U. S. Army, Deshon General Hospital, Butler, Pennsylvania.*

6. Acoustical Trauma as Encountered in Submarine Duty. C. W. SHILLING, *Captain (MC), U. S. Navy.*

7. Design of Non-Reverberant Rooms for Acoustic Measurements. LEO L. BERANEK, *Harvard University.*

8. Air- and Bone-Conduction Audio-Testing Assembly. NORMAN A. WATSON, *University of California at Los Angeles.*—An assembly of apparatus for the testing of hearing by air conduction and bone conduction is proposed which is designed to obviate the use of the soundproofed booth, to eliminate errors common in present techniques, and to provide more comprehensive and accurate tests of hearing than is possible with the usual audiometer. It consists of an adjustable chair and insulated chin rest; a pair of large, adjustable, acoustically-treated air-conduction source-boxes to be placed one over each ear; and an adjustable bone-conduction vibrator, mounted so as to impinge on the center of the forehead of the person being tested. If used in a quiet room, the air-conduction source-boxes would obviate the use of a soundproofed booth and insulate against air radiation from the bone-conduction vibrator without causing false enhanced bone-conduction thresholds. Air-conduction masking should always be used on one ear while testing the other by bone conduction and should be used on the better ear when testing the poorer ear by air conduction. Such an assembly, with an appropriate set of microphones, phonograph pick-up and turn table, oscillators, amplifiers, attenuators, equalizers and filters, would provide the possibility for equal-loudness as well as threshold measurements and for articulation testing with selective amplifiers by diotic as well as by monaural listening, and by various combinations of air- and bone-conduction receivers. Thus it would provide, at relatively small expense and without a soundproofed room or booth, the extensive and intensive tests of hearing for diagnosis of hearing impairment and prescription of hearing amplifiers previously available only in specialized acoustical laboratories.

9. Evidence for the Existence of Peripheral Auditory Masking. KARL LOWY, *University of Rochester.*—In the course of experiments involving the response of single auditory nerve-fibers, it was found that watch ticks elicit synchronized potentials which can be recorded from a great number of fibers. An almost identical response is easily obtained from the round window. Both can be suppressed by pure tones, a frequency around 4050 c.p.s. being most effective for a particular watch. There is experimental evidence that the tick-response, also if recorded from the fenestra rotunda, consists almost entirely of nerve potentials (aural microphonics being negligibly small in this case). Thus, it is possible to record a practically pure nerve-response from the cochlea. This opportunity was used to determine the locus of suppression of the click-potential by the masking pure tone. It is found that damage to the auditory nerve does not abolish the masking effect. One would therefore conclude that it takes place within the cochlea. This is in agreement with an assumption made by Galambos in his report on suppression of a single nerve-fiber response by a second pure tone.

10. The Consideration of Hearing Aids and Audiometers by the Council on Physical Therapy. HOWARD A. CARTER, *Council on Physical Therapy, American Medical Association.*—This paper consists of a brief account of the activities of the Council on Physical Therapy of the American Medical Association in its investigation of hearing aids and audiometers, the problems encountered in its attempt to advise on the accuracy of advertising and the methods by which evidence is considered.

11. The Role of the College and University Hearing Clinic. MIRIAM D. PAULS, *Special Education Clinics, Indiana State Teachers College.*—The introductory discussion will deal with the factors that have led to the growth of hearing conservation programs in our public schools, and the establishment of broad rehabilitation facilities for military and civilian personnel with a hearing impairment. The role of the college and the university hearing clinic will be pointed out. It would seem logical that these clinics with their broad affiliations and scientifically trained staffs can serve as the clearing house to utilize the research and facilities of the interrelated fields and thus develop sound therapeutic procedures for the rehabilitation of the acoustically handicapped. The major part of the paper will present in some detail the possible scope

prohibitive labor of interpretation. High speed operation is clearly indicated to delineate change of tone quality with time.

31. The Clang Tone of the Pianoforte. Armand F. Knoblaugh, *The Baldwin Company*.—This phenomenon occurs in the bass section of all pianofortes and is termed a "clang" or "wolf" tone by piano makers. It comprises a distinctly audible, high pitched sound, emitted with the bass tone when the string is struck in the usual manner. Its pitch, varying from 500 to 3000 c.p.s. throughout a piano, is constant for any one string but varies with string dimensions, being higher for the shorter, lighter bass wires. The fundamental tones of the corresponding bass strings range from 30 to 100 c.p.s. With the aid of a tone analyzer and other apparatus, the effect has been shown to be due to a longitudinal vibration of the bass string. The velocity along the string has been found to be $(AE/M)^{\frac{1}{2}}$ where A = the cross-sectional area of the core wire, E = the modulus of elasticity of the core wire material, and M = the total mass (core+wrapping) per unit length of the string. Dividing the velocity by twice the length of the string yields the frequency of the clang, confirmed by observation and experiment. The clang has its own system of partials, substantially harmonic. The component of hammer motion tangential to the string is probably an exciting cause and the complex motion of the bass bridge probably permits transfer of energy to the soundboard.

32. The Dipole Microphone. Benjamin Olney, Frank H. Slaymaker, and Willard F. Meeker, *Stromberg-Carlson Company*.—A dipole microphone is defined as a microphone whose response is a function of the pressure difference between two distinct acoustic terminals. One application takes the form of a wearable, close-talking microphone in which only the acoustic dipole element need be located near the mouth of the wearer. The sound is conducted through small tubes and is applied to opposite sides of a diaphragm housed with the remainder of the microphone elements in a case attached to the head or body of the wearer. Such a microphone exhibits strong discrimination against ambient noise. Tube resonances are avoided by correct termination of the tubes at the dipole ends, and without intermediate damping. Expressions are developed for the acoustic pick-up characteristics of a dipole close to a small source; for the over-all frequency response of the microphone; and for the random energy efficiency of a dipole as compared with that of one of its poles. Measured and computed characteristics of an experimental microphone are given.

33. Sound Wave Fields Within Cavities. Richard K. Cook, *National Bureau of Standards*.—Cylindrical cavities of circular cross section are extensively used in acoustics in the calibration of microphones and receivers. Such a cavity having plane ends is assumed to be driven by motion of one of the plane ends. Solutions of the wave equation in the form of Fourier-Bessel expansions for the distribution of pressure and particle velocity (as a function of frequency) within the cavity are obtained. The theoretical results are compared with experimental measurements of amplitude and phase of sound pressure within cylindrical cavities.

34. Ear and Closed Coupler Acoustic Impedance. G. S. Cook and P. Chrzanowski, *National Bureau of Standards*.—The Flanders method for measurement of acoustic impedance[1] has been adapted to the measurement of ear impedance. The results of measurement of ear impedance as seen through the caps of several types of audiometer receivers are reported. These are compared with similar measurements on a standard closed coupler used for receiver calibration. The suitability of present couplers for receiver calibration is discussed.

[1] Bell Sys. Tech. J. 11, 402 (1932).

35. A Wide-Range Adjustable Acoustic Impedance. Willard F. Meeker and Frank H. Slaymaker, *Stromberg-Carlson Company*.—A method for obtaining a wide range of calculable impedance values has been developed. Three telescoping tubes are used, one being acoustically "infinite" in length. This "infinite" tube is used as a convenient, calculable impedance terminating the device. The effective lengths of the remaining two sections are varied to adjust the input impedance, whose value may then be calculated in terms of that of the "infinite" section. A unit having an input section 1 inch in diameter and an "infinite" section 0.130 inch in diameter has been constructed. The range of impedance values obtainable is best described in terms of a resistance-reactance plot. On such a plot the range at 800 c.p.s. for the 1-inch diameter unit includes the impedance values enclosed by a circle having its diameter on the resistance axis and determined by the points $R=0.194$ acoustic ohm, $X=0$ and $R=342$ acoustic ohms, $X=0$. The theory is developed, and measured and calculated impedance values for several conditions are compared.

36. Propagation of Sound in Lined Ducts. Charles T. Molloy, *Material Laboratory, Navy Yard, New York, New York*.—This paper presents the theory of the propagation of sound in lined ducts, developed from a uni-dimensional wave equation. This approach was first used by Sivian. Differential equations are derived for ducts with similar linings on all walls and for ducts having different linings on each wall. A general formula is given for the attenuation constant and various special cases are discussed. Graphs are given which make the practical calculation of attenuation in ducts convenient. The variation of attenuation constant with duct size is discussed and methods for calculation of acoustical impedance from attenuation measurements given.

37. The Baffle Effect of the Human Body on the Response of a Hearing Aid. Wilbur W. Hansen, *The Maico Company*.—Theoretical and experimental curves are presented to show the change in response of an electronic hearing aid produced when it is worn by a person. Effects produced by placing the aid in different positions on the person and by aids and persons of different sizes are shown and discussed. The effects shown are large enough to warrant their consideration in describing the response of a hearing aid.

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Nov. 14, 1950 D. W. MARTIN 2,529,562

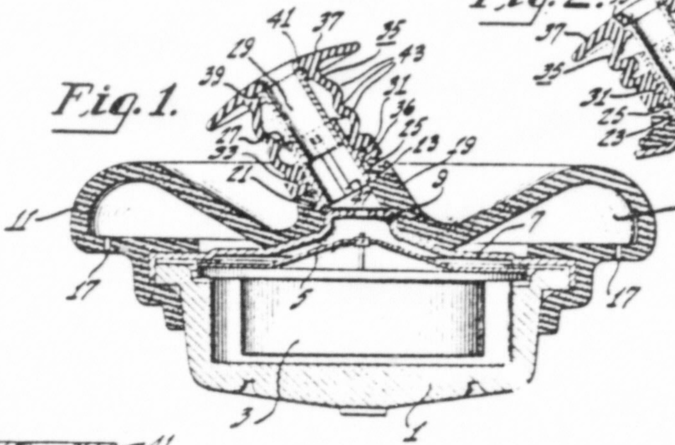
ADJUSTABLE EARPIECE FOR RECEIVERS

Filed Jan. 2, 1947

2a

Fig. 2.

Fig. 1.



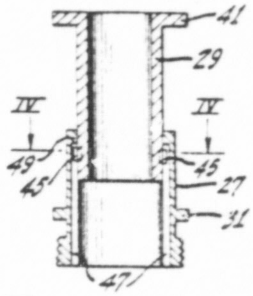


Fig. 3.

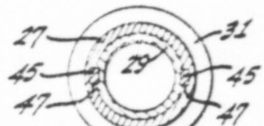


Fig. 4.

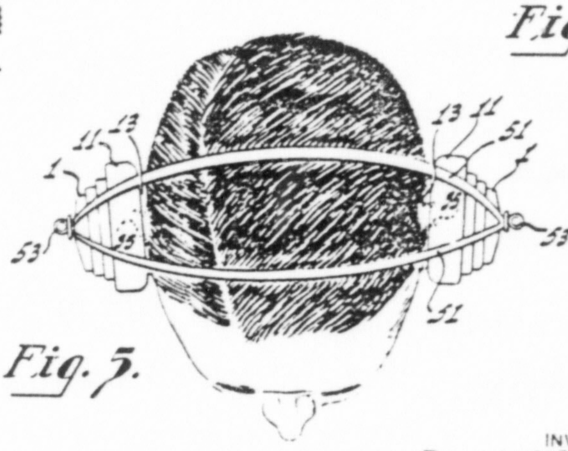


Fig. 5.

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Patented Nov. 14, 1950 2,529,562

UNITED STATES PATENT OFFICE

2,529,562

ADJUSTABLE EARPIECE FOR RECEIVERS

Daniel W. Martin, Blackwood, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application January 2, 1947, Serial No. 719,651

13 Claims. (Cl. 179—182)

1

This invention relates to telephone receivers of the type that are worn on the head and are commonly referred to as headset receivers, and more particularly to an earcap for use on such receivers.

Headset telephone receivers are frequently used in locations where surrounding noise is at a high level, as in battleships, airplanes, and the like. When the external noises are loud, the signal to noise ratio is correspondingly low and it becomes difficult to hear the signals clearly. To avoid this condition, various types of earcaps have been proposed heretofore for use on receiver units for the purpose of sealing the ears of the user against external noise. However, such earcaps have not proven satisfactory for one reason or another.

The primary object of my present invention is to provide, in a headset telephone unit, an improved earcap which will effectively seal off external noises when applied to the ear so that the signal to noise ratio will be maintained quite high.

More particularly, it is an object of my present invention to provide an improved earcap for headset receivers by means of which a great reduction in external noise will be obtained and thereby the sensitivity and low frequency response of the receivers will be greatly improved.

Another object of my present invention is to provide an improved earcap for headset receivers which will effectively acoustically seal against external noises not only the outer ear but also the auditory canal of the ear at the point of maximum flare in the auditory canal cross section.

Still another object of my present invention is to provide an improved earcap as aforesaid which may be made in one size and shape and yet will accurately fit ears of various sizes.

A further object of my present invention is to provide an improved earcap as aforesaid which can be worn with great comfort by the user.

Still a further object of my present invention is to provide an improved earcap as above set forth which can be applied to the ear quickly and accurately and which is not apt to become dislodged easily to a position where it will be ineffective to seal the ear against external noises.

It is also an object of my present invention to provide an improved earcap for headset receivers which is simple in construction, inexpensive in cost, and highly efficient in use.

In accordance with one form of my present invention, the earcap comprises a pad of soft

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rubber, such as sponge rubber, constructed to be mounted on the casing of a headset receiver and adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor. The pad has a central opening and it is provided over said opening with a tubular member which extends therefrom and which preferably terminates in a flange adapted to seat against the auditory canal of the ear at the entrance thereof (that is, where the auditory canal is of maximum flare in cross section) to thereby provide an internal acoustical seal for the ear. The tubular member is preferably made of fairly thin, soft rubber and is disposed with its axis angularly related to the axis of the aforementioned pad, the angle being such that, when the pad is applied to the ear, the tubular member will extend to the auditory canal at the proper angle.

The aforementioned tubular member is formed with one or more circumferential accordion pleats whereby it is collapsible and expansible along its own axis for accomodation to ears of different sizes. Since the tubular member is made of thin rubber and is, therefore, flexible, it is capable of flexing or bending in all planes passing through its axis. To prevent this tubular member from so bending when it is applied to the ear, I provide within it a pair of rigid, telescopically arranged tubes one of which slides within the other as the tubular member expands or contracts. The telescopic arrangement of the tubes permits free collapse and expansion of the tubular sealing member while at the same time preventing bending of this member. In this way, the angular relation between the axis of the tubular extension on the ear pad and the axis of the ear pad itself or the vibratory diaphragm forming part of the transducer unit in conventional telephone receivers is maintained constant. At the same time, however, the tubular sealing member is free to be adjusted and to accommodate itself to ears of different sizes whereby a good seal can be obtained for the ear.

The novel features that I consider characteristic of my invention, both as to its organization and method of operation, as well as additional objects and advantages thereof, will better be understood from the following description of one embodiment thereof when read in connection with the accompanying drawing in which

Figure 1 is a central sectional view of a telephone receiver with an earcap according to my present invention applied thereto and with the tubular member which acts as a seal against

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the auditory canal shown in fully expanded position,

Figure 2 is a fragmentary sectional view of my improved earcap showing the aforesaid tubular member in contracted or collapsed condition such as it would occupy when applied to the ear,

Figure 3 is an enlarged, central, longitudinal, sectional view of the telescopically arranged tubes within the aforesaid tubular sealing member and which maintain this member against flexure or bending in planes containing the axis thereof,

Figure 4 is a sectional view taken on the plane of the line IV—IV of Figure 3, and

Figure 5 is a top plan view showing a headset comprising a pair of receiver units provided with my improved earcap applied to the head of the user.

Referring more particularly to the drawing wherein similar reference characters designate corresponding parts throughout, there is shown, in Figure 1, a telephone receiver having a casing 1 within which is housed an electro-acoustical transducer 3 of any suitable type. The transducer 3 may be a sound powered telephone unit, for example, operating in well known manner and having a diaphragm 5 which generates acoustical waves during vibration thereof. A guard plate 7 having a perforated, central extension 9 serves to protect the diaphragm 5, the perforations in the extension 9 serving to permit passage of sound waves generated by the diaphragm 5.

Fitted around the marginal portions of the casing 1 and the guard plate 7 is an ear pad 11 which may be molded out of sponge rubber or other suitable, soft material. The pad 11 is adapted to be placed against the outer ear 13 of a user, as shown in Figure 5, to provide an external acoustical seal against sounds in the ambient. If desired, the pad 11 may be made hollow to provide a chamber 15 which communicates with the outside air through a plurality of openings 17. This provides an air cushion for the pad 11 and helps to insure a snug fit of the pad against the ear whereby both comfort to the wearer and a good seal against external sounds are assured.

The pad 11 is provided with a tubular extension 19 which fits around the guard plate extension 9 and extends in a direction such that its axis is angularly related to the common axis of the pad itself and of the diaphragm 5 for a purpose to be presently set forth. The extension 19 is formed with an annular slot 21 in which is seated the flange 23 of an internally threaded, metallic insert 25. The outer one of a pair of telescopically arranged, rigid, metallic tubes 27 and 29 is threaded into the insert 25 and is provided with a flange 31 which seats in an annular slot 33 of a tubular member 35 made of fairly soft rubber and therefore quite flexible. The tubular member 35 is held in place against the ear pad extension 19 in extension thereof by having its base flange 36 clamped firmly between the insert 25 and the flange 31 of the tube 27. The member 35 terminates in a flange 37 adjacent to which it is formed with an annular slot 39 in which is seated a flange 41 on the inner tube 29.

It will be noted that the flexible, tubular member 35, the two rigid, telescopically arranged tubes 27 and 29, and the ear pad extension 19 are all arranged on a common axis which is angularly related to the common axis of the ear pad proper and the diaphragm 5. This angular relation is such that, when the receiver is applied to the ear, the tubular member 35 will extend in the direction of (that is, substantially coaxially with) the auditory canal of the ear, and the flange 37 will fit snugly against this canal at the point of maximum flare thereof in cross section (that is, at the entrance thereto) to thereby provide an internal acoustical seal for the ear. The combined action of the pad 11 and the flange 37 effectively seals the ear against troublesome outside noises which may be encountered and therefore not only enhances the low frequency response of the receiver but also improves the sensitivity thereof.

Since the ears of different individuals vary in size, some provision must be made to insure a snug fit of the flange 37 against the auditory canal entrance. For this purpose, the tubular member 35 is formed with one or more circumferential, accordion pleats 43 by reason of which it is axially compliant and therefore collapsible in an axial direction from its normally fully extended position of Fig. 1 to its contracted position of Fig. 2, and vice versa. A pair of diametrically opposed lugs 45 on the tube 29 which ride in longitudinal slots 47 in the tube 27 limit the outward movement of the tube 29 relative to the tube 27 by engagement with the upper end 49 of the tube 29 to thereby limit the amount or extent of expansion of the tubular member 35. Engagement of the portion of the member 35 under the flange 41 with the end 49 of the outer tube 27 may be availed of to limit the amount of collapse of the tubular member 35, if necessary. The collapse and expansion of the member 35 is permitted by reason of the telescopic action of the tubes 27 and 29. At the same time, since the tubes 27 and 29 are rigid, they maintain the flexible, tubular member 35 against flexure or bending in planes containing its axis. In this way, the angular relation between the axis of the tubular member 35 and the axis of the ear pad 11 and the diaphragm 5 is maintained constant and a proper fit of the flange 37 against the auditory canal entrance is further assured.

A pair of receivers with earcaps such as described above may be mounted on a headband consisting of two, close-fitting metallic bands 51 which are adapted to fit over the head, as shown in Fig. 5. Preferably, the headbands 51 are arranged so that they join at the sides just in front of the ears, where metal strips or links 53 connect the bands 51 with the receivers. As the receivers are placed on the ears, the headband construction causes the receivers to turn easily in such a direction as to help the flanges 37 of the earcaps to seat properly against the auditory canal entrances while at the same time causing the ear pads 11 to fit snugly against the ears.

Although I have shown and described only a single embodiment of my present invention, it will undoubtedly be apparent to those skilled in the art that many other forms thereof, as well as variations in the particular one described, are possible. I therefore desire that the particular form of my invention described herein shall be considered as illustrative and not as limiting.

I claim as my invention:

1. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and a pleated tubular member extending from said pad and terminating in

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Larkin Exhibit No. 1?

a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said pleated tubular member including means whereby it is longitudinally compliant for adjustment in an axial direction for accommodation to ears of different sizes.

2. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and a pleated tubular member extending from said pad and terminating in a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said pleated tubular member also being disposed with its axis angularly related to the axis of said pad and including means whereby it is longitudinally compliant for adjustment along its own axis for accommodation to ears of different sizes.

3. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and a pleated tubular member extending from said pad in a direction such that its axis is angularly related to that of said pad, said pleated tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver and terminating in a flange adapted to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear and including means whereby it is longitudinally compliant for adjustment along its own axis for accommodation to ears of different sizes.

4. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and a tubular member extending from said pad and terminating in a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said tubular member also being disposed with its axis angularly related to the axis of said pad and having means including at least one accordion pleat circumferentially thereof whereby said tubular member is collapsible and expansible along its own axis for accommodation to ears of different sizes.

5. An earcap according to claim 4 characterized by the addition of means in association with said tubular member for limiting the amount of collapse and expansion thereof.

6. An earcap according to claim 4 characterized in that said tubular member is itself flexible in planes containing its axis, and characterized

further by the addition of means in association with said tubular member for maintaining said member against flexure in said planes.

7. An earcap according to claim 4 characterized in that said tubular member is itself flexible in planes containing its axis, and characterized further by the addition of a plurality of telescopically arranged, rigid tubes within said tubular member for maintaining said member against flexure in said planes, said tubes being telescopic to permit collapse and expansion of said member along its axis.

8. An earcap according to claim 4 characterized in that said tubular member is itself flexible in planes containing its axis, characterized further by the addition of a plurality of telescopically arranged, rigid tubes within said tubular member for maintaining said member against flexure in said planes, said tubes being telescopic to permit collapse and expansion of said member along its axis and including means for limiting the telescopic action thereof whereby to limit the amount of collapse and expansion of said tubular member.

9. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, a tubular member extending from said pad and terminating in a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said tubular member being compliant whereby it is normally free to flex in planes containing its longitudinal axis and being formed with accordion pleats circumferentially thereof whereby it is collapsible and expansible along its axis for accommodation to ears of different sizes, and a plurality of telescopically arranged, rigid tubes within said tubular member for maintaining said member against flexure in said planes while permitting collapse and expansion of said member by reason of their telescopic arrangement.

10. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, a tubular member extending from said pad and communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said tubular member terminating in a flange adapted to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said tubular member also being made of flexible material whereby it is normally free to flex in planes containing its longitudinal axis and being formed with accordion pleats circumferentially thereof whereby it is collapsible and expansible along its axis for accommodation to ears of different sizes, and a plurality of telescopically arranged, rigid tubes within said tubular member for maintaining said member against flexure in said planes while permitting collapse and expansion of said member by reason of their telescopic arrangement.

11. In a headset telephone receiver having a casing, and an electro-acoustical transducer within said casing including a vibratory diaphragm, an earcap for the telephone receiver

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adapted to be mounted on the casing over the diaphragm, said earcap comprising (1) a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and (2) a tubular member extending from said pad and terminating in a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said tubular member having communication with said chamber for transmission to the auditory canal of the acoustical waves produced by said diaphragm during vibration thereof and having means including at least one accordion pleat circumferentially thereof whereby said tubular member is collapsible and expansible for accommodation to ears of different sizes without affecting its communication with said diaphragm.

12. The invention set forth in claim 11 characterized in that the axis of said tubular member is angularly related to the axis of said diaphragm.

13. The invention set forth in claim 11 characterized in that the axis of said tubular member is angularly related to the axis of said diaphragm, and characterized further by the addition of means in association with said tubular member for maintaining said angular relation constant.

DANIEL W. MARTIN.

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Feb. 19, 1952 | R. C. GILBERT | 2,586,644

HEADSET

Filed Feb. 10, 1949 | 2 SHEETS—SHEET 1

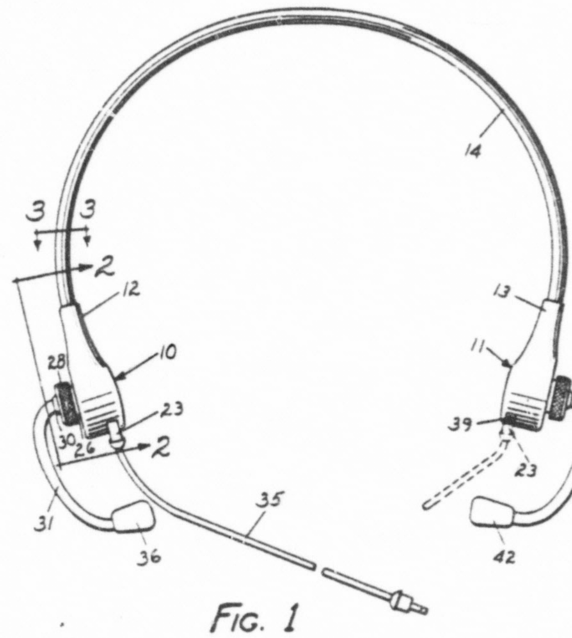

FIG. 1

FIG. 3

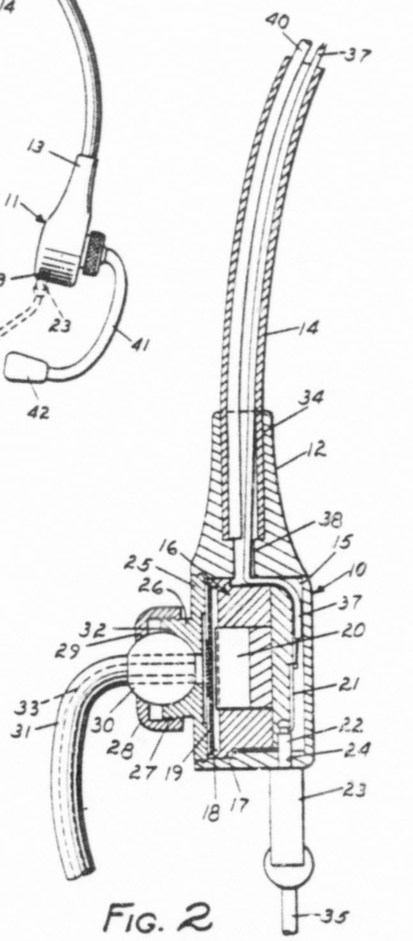

FIG. 2

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Feb. 19, 1952 R. C. GILBERT 2,586,644

HEADSET

Filed Feb. 10, 1949 2 SHEETS—SHEET 2

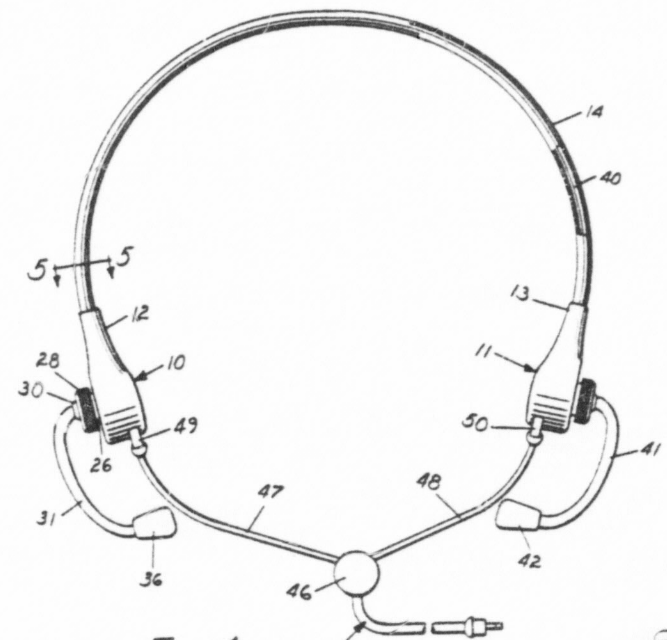

FIG. 4

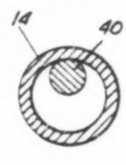

FIG. 5

FIG. 6

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Patented Feb. 19, 1952

2,586,644

UNITED STATES PATENT OFFICE

2,586,644

HEADSET

Russell C. Gilbert, Stillwater, Minn., assignor to Telex Inc., Minneapolis, Minn., a corporation of Minnesota

Application February 10, 1949, Serial No. 75,709

9 Claims. (Cl. 179—156)

1

This invention relates to head sets and more particularly to light-weight head sets of the type which are worn by telephone operators, dictaphone transcriptionists and others over long periods of time. Head sets have previously been provided wherein the sound reproducer units are mounted so as to provide direct communication from the sound reproducer unit to the ear. In such head sets the sound reproducer units have been mounted so as to fit over the ear of the user when the head set is used. In other head sets there have been provided a sound reproducer unit suspended below the chin of the wearer and provided with a harp or wishbone-shaped ear tubes leading to ear tips that are placed in the ears of the operator. All of the foregoing types of head sets are subject to the disadvantage that a certain amount of pressure is applied to the ear of the wearer, which is a sensitive portion of the body and is subject to the disadvantage that such pressure, however slight, when long continued may cause some discomfort of the wearer.

It is an object of the present invention to provide an over-the-head head set which can be worn by the operator for extended periods of time without pressure on the ears of the wearer.

It is more particularly an object of the invention to provide an over-the-head head set wherein the sound reproducing units are worn adjacent the ear and the sound communicated therefrom to ear tips which may be adjusted to any position in proximity with the ear, and either in or out of contact therewith.

It is a further object of the invention to provide an improved, light-weight, over-the-head head set having dual sound reproducer units and also to provide an over-the-head head set having sound reproducer units which, when worn by the operator, are located adjacent the ear and sound conduits provided therefrom equipped for adjustment so as to bring the conduit into close proximity or contact with the ear canal as desired.

Other and further objects of the invention include the provision of an improved light-weight head set having adjustable ear tips on the sound reproducer units and to provide an improved head set having a single or double cord arrangement to dual sound reproducer units of the head set.

Other and further objects of the invention are those inherent in the apparatus herein illustrated, described and claimed.

The invention is illustrated with reference to the drawings in which corresponding numerals refer to the same parts and in which:

Figure 1 is a front elevational view of one form of the invention;

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Figure 2 is an enlarged fragmentary longitudinal sectional view taken along the center line of one of the sound reproducer units of the head set shown in Figure 1 and in the direction of arrows 2—2 of Figure 1;

Figure 3 is an enlarged sectional view taken along the line and in the direction of arrows 3—3 of Figure 1;

Figure 4 is a front elevational view of a slightly modified form of the invention;

Figure 5 is an enlarged sectional view taken along the line and in the direction of arrows 5—5 of Figure 4;

Figure 6 is a quarter front view of an individual wearing the head set of Figure 4.

Referring to Figures 1, 2 and 3 there is illustrated a head set having duplicate sound reproducer casings generally designated 10 and 11, each of which terminates in a side arm 12 and 13 into which a tubular head bow 14 of plastic material or the like is inserted. The construction of the sound reproducer casings 10 or 11 is illustrated by the sectional view shown in Figure 2 wherein it will be noted that the casing is provided with a recess 15 into which the sound reproducer unit generally designated 16 is adapted to repose. The second reproducer unit 16 is of minute size of the type customarily used for hearing aid sets for the hard of hearing. The sound reproducer unit includes an exterior frame 17 terminating at a flange 18 in which the diaphragm 19 of the sound reproducer unit is placed, the diaphragm being held in place by the magnetism of pole pieces 20. Coils surrounding the pole pieces, not illustrated, are connected to a pair of terminals, one of which is shown at 21 in Figure 2. The terminals are in the form of clips to receive parallel terminals 22 of a removable plug 23 which when inserted through holes 24 in the bottom portion of the casing permit connection to the terminals and hence to the sound reproducer unit. The casing 10 is provided with a screw plate 25 threaded or pressed into the casing 10 having an upstanding hub portion 26 that is threaded at 27 to receive the cap 28. The cap has a circular opening in its center and is provided with a spherical recess 29 which serves to hold the ball end 30 of short inflexible ear tube 31 which extends out of the hub 11 and terminates at an ear tip 36, see Figure 1. The hub portion 26 has a spherical recess 32 corresponding to the shape of the ball 30 into which the ball portion 30 is placed before the cap 28 is tightened down. The ball 30 is bored so as to receive the ear tube 31 and the ear tube and ball portion provide a tubular conduit 33 through which the

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sound emanating from the diaphragm 19 is adapted to pass and be delivered to the ear tip 36.

The side arm portion 12 of the sound reproducer casing is bored out at 34 so as to receive the tubular head bow 14 which is preferably of plastic material, although light-weight metal may also be used. In the preferred embodiment of the invention the entire casing 10 is of molded plastic.

In the form of invention shown in Figure 1 a single cord 35 is provided having a pair of conductors which terminate at a plug 23 having a pair of terminal points of wh ch one, viz. terminal 22, is shown in the sectional view, Figure 2, the other terminal point lying immediately behind the terminal 22. These pin terminals are engaged by a pair of spring terminals on the back of the sound reproducer unit 16, of which one such terminal 21 is shown, the other lying immediately behind, and as previously stated these terminals are connected to the coils of the sound reproducer unit.

Also connected to the terminals are a pair of wires in cord 37 which extends around the rear portion and up one side of the sound reproducer unit and thence through the aperture 38 and into the inside of the tubular head bow 14, whence it extends around to the opposite sound reproducer casing 11, which, as previously stated, is identical with that shown at 10 and in Figure 2 just described. In that sound reproducer casing 11 the cord pair 37 is connected to corresponding terminals on the back of the sound reproducer contained within casing 11. It will be noted that the casing 11 has a pair of apertures at 39 to which the pin terminals of plug 23 may be inserted when it is desired to plug in the cord to the sound reproducer casing 11 instead of to the sound reproducer casing 10, as shown. In this way the operator has freedom of choice in that she may plug the cord 35 into either of the sound reproducer casings, depending upon which side she desired to have the cord hung when the set is worn. Within the tubular head bow 14 there is also placed a springy stiffening wire 40 which provides slight pressure and still, when bent, can be adjusted as to to fit the heads of individual operators.

When the sound reproducer shown in Figures 1-3 is worn on the operator, the sound reproducer casings 10 and 11 are positioned at approximately the temples of the wearer and the ear tubes 31 and 41 extending from the sound reproducer casings 10 and 11, respectively, and terminating in ear tips 36 and 42, are then adjusted by the operator so that the ear tips reach into proximity to the ear canal. It is unnecessary, for satisfactory operation, to have the ear tube actually in contact with the wearer, although some may desire to adjust the ear tubes to such position. Consequently, the wearer may, if desired, adjust the ear tubes so as to receive the sounds delivered by the ear tips 36—42 without enduring any pressure whatever on the ear canel or any portion of the ear, the slight tension of the bow 14 which provides the pressure of sound reproducer casings 10—11 on the wearer being taken instead by the sturdier portions of the head of the wearer, viz. the temples portion. Also, if desired, the wearer may shift the head set from one position to another so as to shift the pressure of the sound reproducer casings 10—11 from one spot to another on the temple or over-ear or behind-ear portions of the head and in any position the short adjustable ear tubes 31—41 can be repositioned so as to bring the ear tips 36—42 into proximity with the ear canal. This is a distinct advantage when the device is worn for long periods of time.

Referring to the device shown in Figure 4, it is exactly the same as that shown in Figures 1-3 with the exception that the interconnecting pair of wires 37 between the sound reproducer head set is omitted in the over-the-head bow 14. Accordingly, the sound reproducer units within the casing 10 and 11 are not interconnected electrically and for the purpose of communicating the electrical sound-signals to the sound reproducer unit there is provided a branched cord shown generally at 45 terminating in a connection block 46 from which a pair of cords 47—48, which are connected parallel to the wires of cord 45, emanate. The cords 47—48 are each provided with plugs connectors at 49—50, respectively, which are plugged or jacked into the openings provided in the base of the sound reproducer casings 10—11, thus making electrical connections to the sound reproducers therein. As shown in the sectional view in Figure 5 the over-the-head bow 14 includes a stiffening wire 40 as previously described, but there is no electrical connection in the tube 14. Figure 6 is self-explanatory and illustrates one position in which the head set shown in Figure 4 may be worn by the operator. It is to be understood that the twin cord generally designated 45—46—47—48 shown in Figure 6 may be substituted by the unit shown at 35 in the event the head bow 14 has electrical connection between the sound reproducers of the head set, as explained with reference to Figures 1-3.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments herein.

What I claim is:

1. An over-the-head head set comprising a pair of small sound reproducer units each including an electrical sound reproducer element, said units being mounted at opposite ends of a flexible over-the-head head bow, said sound reproducer units having substantially smooth faces opposing each other and each of said sound reproducer units being provided with a short ear tube movably connected in operative sound-communicating relation thereto, at a point other than said smooth face of the unit for adjustably positioning the ear tube with reference to the unit when the head set is worn, electrical connections between the sound reproducer elements and an exterior cord connected to said elements.

2. An over-the-head head set as set forth in claim 1 further characterized in that the ear tubes are connected to the sound reproducer units by a ball and socket connection having an adjustable frictional engagement for holding the ball connection in any position to which it is adjusted.

3. An over-the-head head set as set forth in claim 1 further characterized in that electrical connection is made between the electrical sound reproducer elements by means of a pair of electric wires contained within the over-the-head bow and plug connections are provided at each sound reproducer unit for receiving a cooperating electrical connection of an exterior cord.

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4. A sound reproducer unit of the type set forth in claim 1 further characterized in that parallel electrical connections are made to each sound reproducer element from an exterior supply pair.

5. An over-the-head head set comprising a tubular head bow, a casing connected at each end of the head bow, said casing having a substantially smooth face facing the other casing, a sound reproducer in each casing, each sound reproducer having a diaphragm, each of said casings having a tubular protuberance adjacent the diaphragm providing a conduit through which sounds emanating from said diaphragm may be communicated, said tubular protuberance extending from said casing on a face other than said smooth face and a short adjustable ear tip connected to said protuberance for adjustment to varying angular dispositions relative to the conduit therein, each said ear tube terminating in an ear tip, and electrical connections from the sound reproducer in one casing and through the tubular head bow to the sound reproducer unit of the other casing.

6. The head set described in claim 5 further characterized in that each casing is provided with a pair of spring terminal connections and apertures adjacent thereto for receiving pin connections of an exterior plug cord for supplying the sound reproducers of the head set.

7. An over-the-head head set comprising a tubular plastic head bow, a molded plastic casing at each end of the head bow, each such casing having a relatively smooth face facing the other casing and being provided with a recess for receiving a sound reproducer unit of the hearing aid type therein, each casing having a channel therein communicating with the channel of the tubular head bow, a sound reproducer unit positioned in the recess of each casing, a metallic cap removably attached to the casing, said metallic cap and sound reproducer unit of each casing being formed so that when the cap is attached pressure is placed upon the sound reproducer unit for holding the same firmly within the casing, each said cap having a central tubular boss, having a spherical central recess therein, an apertured cap screw threaded upon said boss and an ear tube, each ear tube terminating in a ball received in said spherical recess and an ear tip on each ear tube.

8. The over-the-head head set of claim 7 further characterized in that electrical connection is provided through the tubular head bow from the sound reproducer unit situated in one plastic casing and connected to the sound reproducer unit situated in the other plastic casing.

9. An over-the-head head set comprising a tubular head bow, a casing connected at each end of the head bow, each of said casings having a substantially smooth face facing inwardly of the bow, a recess extending into each of said casings from a face opposite to the smooth face, a sound reproducer unit of the hearing aid type in each of said recesses, an ear tube adjustably connected to each of said sound reproducer units and extending outwardly therefrom and adapted for variably positioning the ear tube with reference to the unit when the head set is worn, electrical connections between the sound reproducer units and an exterior cord connected to said units.

RUSSELL C. GILBERT.

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454,138	Mercadier	June 16, 1891
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2,337,953	Wirsching	Dec. 28, 1943
2,390,794	Knight	Dec. 11, 1945

674

HEADSET NEWS! NOTHING TOUCHES THE EAR WITH

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Ends Headachy Ear Pressure

Twinset receivers rest lightly at the temples—not jammed over the ears. Tubular sound arm pipes signal *into* the ears—chafing, pressure, "top-heavy" feeling banished forever!

Weighs Only 1.6 Oz.

Twinset is the lightest twin magnetic-receiver headset ever made! Of rugged Tenite and bright nickel throughout. New Monocord replaces "Y" cord connection to receivers—another *Twinset* first!

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Plastic ear tips adjustable to fit ear opening snugly, comfortably. Room noise and clatter silenced! Less signal loss, for sound is delivered closer to the ear drum. Signal goes *into* the ear—not *at* it!

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Matched, in-phase magnetic receivers deliver pure, non-resonating signal. Listen hour after hour with *Twinset* without tiring. Precision electrical design throughout!

A BASIC Headset Improvement...

Telex *Twinset* is an entirely new way to hear with a headset! You forget you're wearing it. Never before such comfort, lightness, all-day-long ease of use.

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Twinset combines performance—sensitivity, high-fidelity, precision construction—with unique improved design. *Twinset* fits any shape head, fits *any* headset installation—commercial, experimental, amateur or business. Featherlight, yet built specifically for constant heavy duty use!

For more details TURN PAGE

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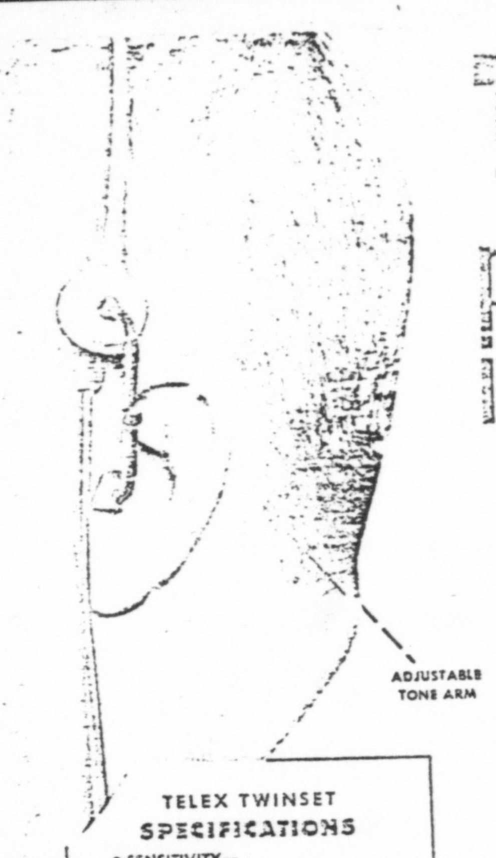
TELEX® TWINSET pipes signal directly into the ear....



CAA APPROVED (CAATC-3R2-1)

TELEX ***Twinset*** is a simple yet amazing improvement in listening comfort.

No heavy, sweaty ear cups cover the ear. *Twinset's* matched magnetic receivers re[illegible] on the temples —*away* from the ear. Actual sound is piped into the ear through a slender, tubular sound arm mounted on a ba[illegible]-and-socket joint.

Sound arm and ear tip are adjustable to fit *into* the ear—blocking out background noise completely, giving you more power on weak signals. If preferred, ear tip may float a fraction of an inch away with *nothing whatever touching the ear!*

Telex ***Twinset*** **is fully adjustable** to fit any head shape, any ear size. Listen with one or both ears. Move your head, walk around—*Twinset* stays with you without pressure or top-heavy feeling. Remember that weight: only a fraction over an ounce!

Superb performance is built into *Twinset*. Both the magnetic receivers are in phase. Excellent sensitivity combined with full range high-fidelity makes *Twinset* perfect for communications and experimental installations.

Twinset **can take abuse!** Receivers are sealed against dust and corrosion —chrome-plated, weighted diaphragm is rust-proof, too. Rugged Z-nickel steel head band, encased in Tenite plastic, is so flexible you can coil up *Twinset* and stuff it in your pocket. Single 5-foot Monocord connects to either receiver—stays out of the way better than old-style "Y" cords.

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For Better Listening . . . Specify Telex Twinsets in:

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- Commercial Communications
- Pilot and Control Tower
- Ship's Radio
- Broadcast Monitoring
- Electronic Labs
- Code Practice Schools
- Stenographic Transcribing
- Police and Taxi Dispatching
- Phone-order Boards
- Theaters
- Record Stores
- Wired Music Installations
- Hospitals

Listen Comfortably...Privately...Efficiently...with TELEX TWINSET -the Improved, Modern Headset

TELEX TWINSET SPECIFICATIONS

- **SENSITIVITY—**
  101 d.b. above .000204 dynes per sq. cm. for 10 microwatts input
- **IMPEDANCES—**
  1000 ohms—(brown)
  64 ohms—(yellow)
  The above impedance color coding is visible inside the femal[illegible] plug socket.
- **CONSTRUCTION—**
  Weight: 1.6 oz.
  Tough, dur[illegible] [illegible]e plastic and brigh[illegible] [illegible] [illegible] major parts.
  Headband of Z-nick[illegible] s[illegible]el wire encased in flexible plastic.
  Single 5-foot Monocord plugs into either receiver.
  Special cord with built-in miniature volume control also available.

HOW TO ORDER

#3775 TWINSET—Complete with 5 Ft. Monocord—(1,000 ohm) CAA Approved
#3791 TWINSET—Complete with 5 Ft. Monocord—(64 ohm)
#3776 TWINSET—less cord (1,000 ohm) CAA Approved
#3781 TWINSET—less cord (64 ohm)
#3280 MONOCORD only.

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Printed in U.S.A. 381008 (Rev. 10-55)

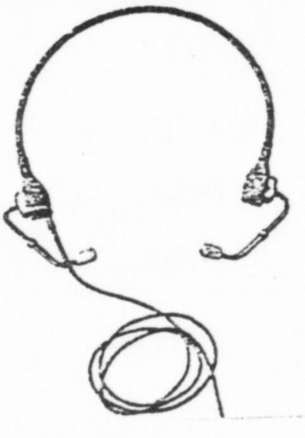
BOOM-MIKE HEADSET This lightweight, 3½-ounce, two-way headset is ideally suited to airline, ham radio, television, ship-to-shore and switchboard use. Parallel connected 500-ohm receivers are mounted on stainless spring-steel headband. Adjustable tone arms transmit sound directly to ears—no heavy, sweaty cans. Mike is mounted in shock absorbing tenite at end of fully adjustable boom—angled for best pickup. Choice of general purpose 50 ohm carbon mike (output 30 db above 1MV) or 256-ohm noise cancelling differential magnetic mike (output—85 db below 1 Volt/Microbar).

BE SURE TO ORDER BY CATALOG NUMBER

Stock Number		Catalog Number Carbon Mike	Catalog Number Noise Canceling Mike
13250	Headset w/double receivers & 5' cord w/terminal clips less plug	BCW-12	BMW-12
18250	Headset w/single receivers & cord as above	BCW-11	BMW-11
18240	Headset w/no receivers, mike only & cord as above	BCO-1	BMO-1
18230	TV type headset w/double receivers, split phone & cord as above	BCW-02	BMW-13
18200	Headset w/double receivers, no cord	BCW-01	Not Available
18229	Headset w/single receiver, no cord	BCW-03	"
18235	Headset—split phone, no cord	CME-1	–
Lugs	Cord unit w/term. packed separately, no plug	CME-5	*
9251	Aircraft-type cord w/PL-55 and PL-68 or equiv.	CME-3	*
12061	Aircraft-type cord w/push-to-talk switch	CME-2	*
9262	Standard cord w/PL-68 or equiv.	CME-4	*
Lugs	Switchboard-type cord w/standard plug		*
Lugs	"Y" cord, 6 conductor, for headset #18235 w/term. packed separately, no plug	CME-56	
	3280-22 *Cord unit for receivers for noise cancelling mike equipped headsets (order plug separately)	CMM-1	

MONOSET® Here's the ORIGINAL under-chin, lightweight headset. Ideal for listening systems, business machines, radio and record listening, broadcasting, and nearly any other application. Weighing only 1.2 oz., it is complete with 5' cord and standard phone plug. Sensitivity is 38 db above. 0002 dynes per sq. cm. for 10 microwatts input. Frequency response: 100 to 6500 cycles.

Stock Number	Catalog Number
#18183—MONOSET, 128 ohm, complete, std. cord	HMV-2
#18184—MONOSET, 2000 ohm, complete, std. cord	HMY-2
#18185—MONOSET, 128 ohm, with volume control cord	HMV-7
#18186—MONOSET, 2000 ohm, with volume control cord	HMY-7
#18110—MONOSET, 128 ohm, NO CORD	HMV-01
#18165—MONOSET, 2000 ohm, NO CORD	HMY-01
# 9241—CORD, Standard (for metal monoset)	CMT-2
# 3230—CORD, Standard (for plastic monoset)	CMM-2

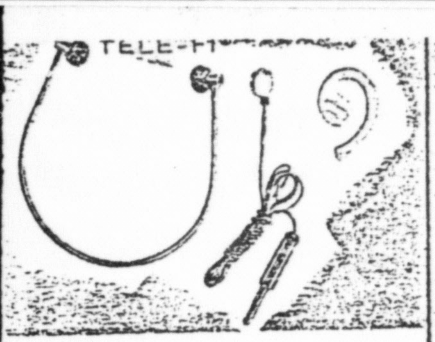


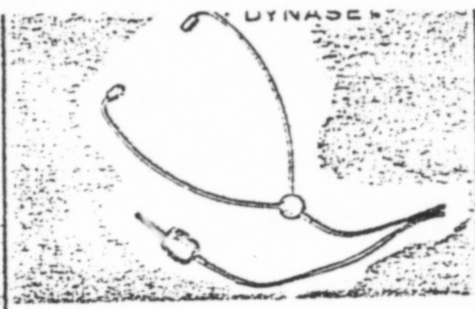
TWINSET® Perfect for amateur, commercial, and industrial communications, the Twinset is CAA approved and is standard equipment on airlines and private planes. Comfort replaces listening fatigue. Adjustable tone arms pipe sound into ears, blocking out background noise, yet ear-tips need not even touch user's ear. Weighs 1.6 oz. and has 5' cord and standard phone plug. Special cord with built-in miniature volume control also available.

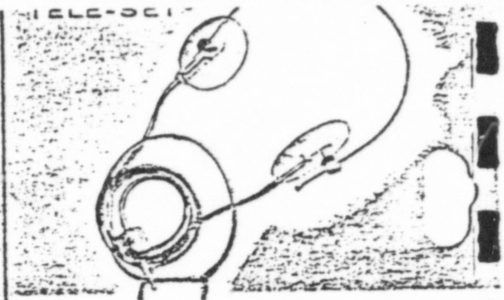
Sensitivity is 101 db above .0002 dynes per sq. cm. for 10 microwatts input.

Stock Number	Catalog Number
#3791—TWINSET, 64 ohm imp, complete, std. cord	HTL-2
#3775—TWINSET, 1000 ohm imp, complete (CAA app.), std. cord	HTX-2
#3781—TWINSET, 64 ohm imp. LESS CORD	HTL-01
#3776—TWINSET, 1000 ohm imp. LESS CORD (CAA app.)	HTX-01
#2846—Volume Control Cord, 64 ohm imp	VVM-2
#2845—Volume Control Cord, 1000 ohm imp	VXM-2

LTLA







Sound reaches one ear before the other ear to provide "depth of sound" and 30% better understanding. Ideal for secretaries, order board operators, monitoring, etc. Weight of only ½ oz. Replaceable foam eartips assure maximum comfort. Standard phone plug and 5' cord included.

Sensitivity provides comfortable listening at 1 milliwatt input. Frequency response: 50 to 5,000 cycles. The Tele-Fi chin band is useable with all Telex transistor receivers.

Stock Number	Catalog Number
#18135—TELE-FI, 15 ohm, std. cord	HFR-91
#18035—TELE-FI, 128 ohm, std. cord	HFV-91
#18020—TELE-FI, 1000 ohm, std. cord	HFX-91
#18160—TELE-FI, 2000 ohm, std. cord	HFY-91

Pleasing tone quality important to all users, extremely light weight! Excellent for all types of radio, record, and listening uses, the Dynaset also is ideal for phone-order boards, office machines, and commercial applications. Sound is conducted through long-life flexible tubing from receiver built into the special plug. Sensitivity is 105 db above .0002 dynes per sq. cm. for 1 milliwatt power input. Recommended maximum input: 25 mw. Frequency response: 50 to 8,000 cycles. Weighs 1.25 oz. and comes complete with special plug and acoustic tube.

Stock Number	Catalog Number
6701-P—DYNASET, impedance 6 ohms	HUP-01

Unique muff-type headset used extensively for electric organ practice. Also popular in office, shop, studio, or lab. The receiver is in the special plug, and sound is piped through acoustic tubing to the thin Plexiglas ear cushions. Total weight only 1.6 oz. Special plug and 5' acoustic tube included.

Stock Number	Catalog Number
#8825—TELE-SET, Complete, 128 ohm	HSV-01
#9316—TELE-SET, Complete, 2000 ohm	HSY-01

TELEX superior quality headsets and accessories

PILLOW SPEAKERS

Comfortable radio, sound, tape recorder or TV listening through pillow. Popular in hospitals and homes because you listen without disturbing others, also for learn-while-sleep applications. DYNAMIC type features stainless steel housing with a hanger. Weighs 4 oz. and measures 3¼" x 1⅛". MAGNETIC type has unit molded maroon case. Diaphragm is rust and moisture proof and hermetically sealed. Can be sterilized by submerging in alcohol. Weighs 2.6 oz. and measures 2¼" x ⅜". BOTH TYPES come with 5' cord and standard phone plug. Miniature plug available. Sensitivity of Dynamic Speaker is 1 milliwatt input to speaker for comfortable listening level.

Stock Number	Catalog Number
#8110—DYNAMIC PILLOW SPEAKER, 3.2 ohm imp.	SDN-2
#8130—DYNAMIC PILLOW SPEAKER, 10,000 ohm imp.	SDM-2
#8197—DYNAMIC PILLOW SPEAKER, 10,000 ohm imp. with volume control cord	SDM-7
#4500—MAGNETIC PILLOW SPEAKER, 128 ohm imp.	SMV-2
#4530—MAGNETIC PILLOW SPEAKER, 2000 ohm imp.	SMY-2
#4501—MAGNETIC PILLOW SPEAKER, 128 ohm imp. NO CORD	SMV-01
#4531—MAGNETIC PILLOW SPEAKER, 2000 ohm imp. NO CORD	SMY-01
#2845—Volume Control Cord, MAGNETIC ONLY, 128 ohm imp.	VVM-2
#2844—Volume Control Cord, MAGNETIC ONLY, 2000 ohm imp.	VYM-2
#9238—Volume Control Cord, DYNAMIC ONLY, 10,000 imp.	VMD-2

MICROPHONE

Reliable, field tested, heavy duty microphone with push-to-talk switch is especially adaptable to applications in Civil Defense, law enforcement, emergency services, search and rescue, durable construction, inter-plane or aircraft radio communications. Microphone is single button, carbon type N-1, identical to telephone switchboard headsets. Fits operator's hand comfortably, and light button pressure eliminates hand fatigue even through day long use. Sensitivity 1000 cycles is 30 db above one inVin a 20 ohm resistive load at sound pressure of 115 db. Button current 75 ma recommended 150 ma max. Single pole, single throw switch is normally open. Three foot cord with tinned leads, no connector.

	Stock Number	Catalog Number
Part Numbers	#18430	MCS-1

MEGAPHONE

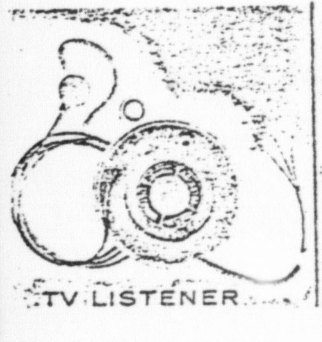
Available with pocket type or collar type alligator clip. The Telex Megaphone can be used with any Standard Miniature earphone. Ideal for transistor radios either in personal entertainment or commercial communication. Presently in use by law enforcement agencies and other two way radio applications.

Stock Number	Catalog Number
#18301—Pocket Type	AEH-1
#18309—Collar Type	AEH-9

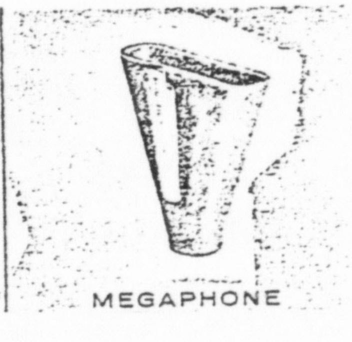
TV LISTENER

Youngsters can view TV without disturbing family. Also ideal for institutions and hard-of-hearing. Two can use at the same time. Switch to turn TV speaker on or off, volume control, and 15' cord included. Child can use easily and safely.

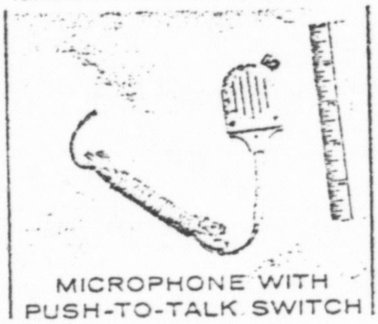
Stock Number	Catalog Number
#9900—LISTENER, complete, one Earset	LCP-90
#9338—Extra Earset, cord & plug	ELV-98



TV LISTENER



MEGAPHONE



MICROPHONE WITH PUSH-TO-TALK SWITCH

PILLOW SPEAKERS

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earsets

Modern, miniature earphone that slips on the ear. Unlimited single phone applications including transcribing, phone order, lab, record shops, dispatching, multiple listening, transistor radios, etc. Uses one ear leaving the other free. This sealed unit weighs ½ oz. and will fit any ear. Available with plastic or slim, plastic-covered metal earframes. Standard phone plug and 5′ cord included.

	Stock Number — Catalog Number with PLASTIC earframe	Stock Number — Catalog Number with METAL earframe
EARSET, 15 ohm imp.	#18134—EPR-2	#18092—EMR-2
EARSET, 128 ohm imp.	#18056—EPV-2	# 9334—EMV-2
EARSET, 1000 ohm imp.	#18058—EPX-2	# 9335—EMX-2
EARSET, 2000 ohm imp.	#18138—EPY-2	#18140—EMY-2

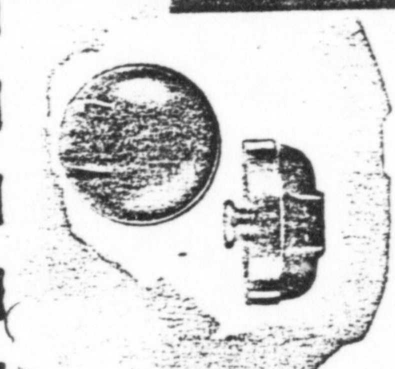
#12045—Volume Control Cord, 128 ohm imp. VVT-2
#12046—Volume Control Cord, 1000 ohm imp. VXT-2

STANDARD AND DELUXE TELETHIN® TRANSISTOR RADIO EARSETS

Engineered in the great tradition of Telex quality. Provides a measurably flatter response than other similar units. Weighs less than an ounce complete with flex-tested three-foot cord and earloop. Price of Standard Earset is competitive with foreign imports. Earsets are packaged individually in pocket-size "jewelite" plastic boxes—6 Standards or 4 *Telethins* to a merchandise display carton. Models to fit *all* transistor radios.

	Admiral	Arvin	Bulova 900B	Dewald	Emerson	G.E. 673	G.E. 510	G.E. 215	G.E. 236	G.E. 225	Hoffman	Magnavox	Motorola	Packard Bell	Philco	RCA	Regency	Roland	Sentinel	Sonora	Sparton	Trav-ler	Western Auto	Westinghouse	Zenith	Catalog Number
TELETHIN assorted box of 4 18315																										ETR-90
18116	X	X		X							X		X		X	X	X	X				X	X		X	ETR-92
18117					X		X		X	X					X									X		ETR-93
18118						X		X																		ETR-94
18120			X									X						X	X	X						ETR-95
STANDARD assorted box of 6 18684																										ESR-90
18681-	X	X	X								X		X		X	X	X	X	X			X	X		X	ESR-92
18682-					X		X		X	X					X									X		ESR-93
18683						X		X																		ESR-94
18680			X									X		X				X	X	X						ESR-95

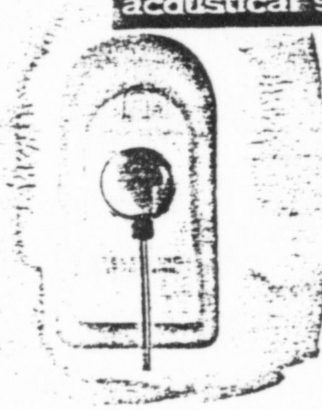
transistor receiver



This transistor receiver is designed for use in portable radios, paging systems, and other miniature audio applications. Sensitivity is 118 db above .0002 dynes per sq. cm. at 1 milliwatt of power at 1000 cycles. Maximum power recommended: 25 mw. Weighs only ¼ oz. and measures ⅓" x 13/16". Can be used with a variety of cords available from Telex.

Stock Number	Catalog Number	IMPEDANCE	D.C. RESISTANCE	MAX. D.C. CURRENT W/O POLARIZING
7688-R4	RTR-04	15	5	30 MA
7692-V4	RTV-04	128	27	12 MA
7694-W4	RTW-04	500	115	5 MA
7696-X4	RTX-04	1000	200	4 MA
7638-Y4	RTY-04	2000	500	2 MA

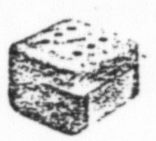
acoustical shell



Used for years in international government and diplomatic meetings, the TELA-EAR acoustic shell when used with Telex earsets is also popular for churches, dictation, phone order, lab work, record stores, and multiple listening systems. Sanitary shield transmits sound to ear without receiver touching it. Fits either ear—leaves the other free for phone or conversation. Weighs less than 1 oz.

Stock Number		Catalog Number
#18013	Shell only (order EP or EM Earsets separately)	AEM-2

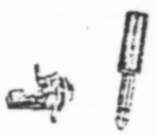
SUB-MINIATURE COMPONENTS AND ACCESSORIES



MINI-MIKE®

Performs ideally in any application requiring a miniature electro-acoustic transducer—including dictating machines, transceivers, etc. A dynamic speaker and microphone are housed in case 1" x 1" x ¾" weighing 1⅓ oz. Impedance is 10 ohms. Sensitivity as mic. is 52 db below 1 volt per dyne per sq. cm. of sound pressure (with match. xfmr.). Sensitivity as speaker is 124 db with 10 milliwatts of power input.

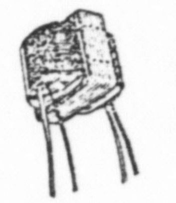
Stock Number	Catalog Number
#9155—MINI-MIKE, Model 100	MDP-01
#8518—Matching Xformer, input to grid, 10 to 150K	....



SUB-MINIATURE JACKS AND PLUGS

Miniature phone plug and closed-circuit jack, ⅓ the size of previous models, are ideal for computing devices, dictating machines, transistor radios, tape recorders, and similar applications. Jack has nickel-plated brass bushing, .228" dia. mounting, grade XXXP phenolic insulator. Plug is nickel-plated brass, nylon insulator, and Tenite II housing (flesh or gray).

Stock Number	Catalog Number
# 9245—JACK, closed circuit panel mnt.	JMP-01
#12102—JACK, open circuit, panel mnt.	JMP-02
# 9231—PLUG, straight	PM-01
# 9199—Display Card	PJM-24D

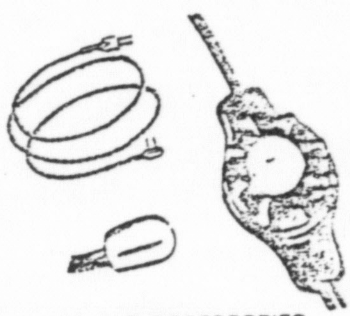


SUB-MINIATURE TRANSFORMERS

Designed for transistorized circuits in radios, paging units, hearing aids, and other audio and ultrasonic applications. High permeability cores and light weight. Series A weighs 4.5 grams, measures ½" x 7/16". Series B weighs 2.4 grams, measures ⅛" x 5/16". Series C is 9/16" x 11/16" x ⅛".

STOCK NO.	TYPE	SERIES	PRI. IMP.	SEC. IMP.
8641	Input	A	200 M	1 M
8642	Interstage	A	20 M	1 M
8643	Output	A	1 M	100
8901	Interstage	B	20 M	1 M
8918	Input	C	10	150 M
8929	Output	A	600	8
8978	Output	A	2M-CT	125
8982	Reactor	A	10 Hen. @ .5 ma 900 ohm DC	
11135	Input	B	200 M	1 M
11137	Output	B	1200	50
11138	Output	A	1 M	10

Stock Number	Catalog Number
12162—Two pronged, standard switchboard plug, gray Nylon housing for telephone switchboards and broadcast jack panels	PS-01



STANDARD CORDS

LESS VOLUME CONTROL, COLOR GRAY, LENGTH 5'

PLUG TYPE	TO FIT Plastic Monoset, Twinset Magnetic Pillow Speaker — Stock Number	Catalog Number	TO FIT Metal Monoset, Tele-Fi, Tela-Ear TV Listener, Plastic Earset, & Metal Earset — Stock Number	Catalog Number	TO FIT Dynamic Pillow Speaker — Stock Number	Catalog Number
Standard Phone Plug	#3280	—CMM-2	# 9241	—CMT-2	4230	—CSD-2
Less Plug—Eyelets Only	#3280-22	—CMM-1	# 9241-22	—CMT-1	Available on Request	
Right angle Miniature Phone Plug	#9200	—CMM-92	#12047	—CMT-92		
Straight Miniature Phone Plug	#9225	—CMM-98	#12048	—CMT-98		
Extension Cord 5' Long	#8555	—CMM-99				
Extension Cord 5' Long			#12246	—CMT-99		

VOLUME CONTROL CORDS, STANDARD LENGTH 5', STANDARD PHONE PLUG

Speaker Impedance	To Fit: Plastic Monoset — Stock Number Catalog Number	Twinset — Stock Number Catalog Number	Magnetic Pillow Speaker — Stock Number Catalog Number	Dynamic Pillow Speaker — Stock Number Catalog Number	Metal Monoset Earsets, Tela-Ear Tele-Sets — Stock Number Catalog Number
64 Ohm	....	#2646-VVM—2	....	....	....
128 Ohm	#2846—VVM-2	....	#2646—VVM-2	....	#12045—VVT-2
500 Ohm	#2845—VWM-2	....	....	....	....
1,000 Ohm	....	#2845—VWM-2	....	....	#12046- VXT-2
2,000 Ohm	#2844—VYM-2	....	#2844—VYM-2	....	#12172—VYT-2
10,000 Ohm	....	....	....	#9238—VMO-2	....

EARTIPS AND ACCESSORIES

Stock Number	Catalog Number
# 3374—Eartips, Plastic Monoset	AMT-1
# 6710—Eartips, Metal Monoset & Dynaset	AMT-2
# 3756—Twinset Eartips, Plastic (white)	ATT-1
# 9635—Twinset Eartips, Rubber (black)	ATT-2
# 8834—Acoustical Shell—Tele-set	ASM-1
#18013—Acoustical Shell—Tela-ear	AEM-2

Earset Frame

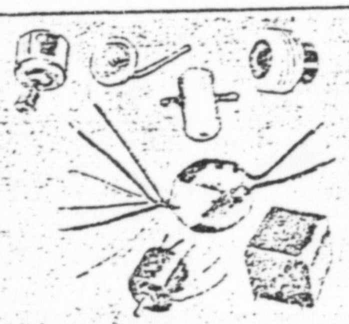
Stock Number	Catalog Number
#16394—Nylon Ear Loop	AEF-3
#15939—Lucite Ear Frame	AEF-1
# 9252—Metal Ear Frame	AEF-2

Accessories for Tele-FI

Stock Number	Catalog Number
#18009—Tele-Fi Plastic Foam Cushions	AFT-1
#18065—Under Chin Tube Complete	AFC-1

Boom-Mike Headset (Use Twinset Eartips)

Stock Number	Catalog Number
#3756—Plastic (white)	ATT-1
#9635—Rubber (black)	ATT-2



TELEX—PIONEER IN MINIATURIZATION

Specialists in custom packaging for computer, military, AEC, missiles . . .
Telex production and testing facilities are geared to specialized requirements of miniaturization, of close
tolerance production, and of special packaging techniques including encapsulation. If you require maximum
component density, maximum reliability, and rigid environmental requirements . . . talk to Telex.
Telex manufacturing space is air conditioned and controlled to 30% relative humidity. Specialized encapsulation equipment provides evacuating, impregnating, recorded temperature controlled curing ovens for highest product quality. We maintain collateral equipment to support these specialized facilities.
Telex has developed special components for its own products including miniature connectors, bobbins, molded gears, housings, patented ball and socket joints, etc. We have injection molding facilities with capacities to 2 oz.
Talk to Telex for toroidal coils, cupcore inductors, and subminiature audio transformers. Coil winding facilities coupled with special packaging experience enables manufacture and testing to customer or military specifications. Packaging done as individual items or assembled into special circuitry, encapsulated or otherwise. Remember . . . talk to Telex.

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TELEX

Electro Mechanical-Acoustic Division

TELEX PARK, ST. PAUL 1, MINN.

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Larkin Exhibit No. 13
For Identification
11-6-73 RJ

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LIGHTWEIGHT HEADSET
AND
BOOM MICROPHONE

ARINC CHARACTERISTIC NO. 535
ISSUED MARCH 25, 1957

KMC
RED
ESW 4-29-57

4-10-57

AERONAUTICAL RADIO, INC.

680

AERONAUTICAL RADIO, INC.
1700 K Street, NW.
Washington 6, D. C.

CHARACTERISTIC NO. 535

LIGHTWEIGHT HEADSET AND BOOM MICROPHONE

Issued: March 25, 1957

Prepared by the Airlines Electronic Engineering Committee

Approved by the Airlines Electronic Engineering Committee:	October 18, 1956
Approved by the Board of Directors:	March 20, 1957
Approved by the Member Airlines:	March 25, 1957

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CHARACTERISTIC NO. 535

Lightweight Headset and Boom Microphone

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FOREWORD

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Activities of Aeronautical Radio, Inc. (ARINC) and the Purpose of ARINC Characteristics

Aeronautical Radio, Inc., is a corporation in which the United State scheduled airlines are the principal stockholders. Other stockholders include a variety of other air transport companies, aircraft manufacturer and foreign flag airlines.

Activities of ARINC include the operation of an extensive system of domestic and overseas aeronautical land radio stations, the fulfillment of systems requirements to accomplish ground and airborne compatibility, the allocation and assignment of frequencies to meet those needs, the coordination incident to standard airborne communications and electronics system and the exchange of technical information. Through the Airlines Electroni Engineering Committee, composed of airline technical personnel, the standards for electronic equipment and systems for the airlines are formulated. The establishment of Equipment Characteristics is a principal function of this Committee.

An ARINC Equipment Characteristic is finalized after investigation an coordination with the airlines who have a requirement or anticipate a requirement, with other aircraft operators, with the military services having similar requirements, and with the equipment manufacturers. It is released as an ARINC Equipment Characteristic only when the interested airline companies are in general agreement. Such a release does not comm any airline or ARINC to purchase equipment so described nor does it establish or indicate recognition of the existence of an operational requirement for such equipment, nor does it constitute endorsement of any manufacturer's product designed or built to meet the Characteristic. An ARINC Characteristic has a two-fold purpose, which is:

(1) To indicate to prospective manufacturers of airline electronic equipment the considered opinion of the airline technical people, coordinated on an industry basis, concerning requisites of new equipment, and

(2) To channel new equipment designs in a direction which can result in the maximum possible standardization of those physical and electrical characteristics which affect interchangeability of equipment without seriously hampering engineering initiative.

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CHARACTERISTIC NO. 535

Lightweight Headset and Boom Microphone

1.0 General Description

1.1 Function - This Characteristic covers the requirements for a lightweight headset with integral boom microphone suitable for pilot use with a conventional airborne radio installation. (There are some users who may desire the headset assembly described herein less the boom-mounted microphone.)

A number of different microphone and headset designs are in use in airline service and meet the users' requirements. This Characteristic is not intended to preclude other designs nor does it imply that this is the only satisfactory headset and microphone. It is also to be recognized that cockpit loudspeakers are widely used in airline service and that this Characteristic in no way reflects on their utility. This is simply a statement of characteristics which a number of air carriers feel constitutes a satisfactory design of a headset and boom microphone.

1.2 Associated Equipment - The headset will normally be used in conjunction with a conventional isolation amplifier. The microphone will use a transistor pre-amplifier to be located at or near the microphone jack to raise the voice level to a value equivalent to carbon microphone output.

1.3 Applicable Publications, Specifications and Drawings -

(a) ARINC Report No. 403, "Guidance for Designers of Airborne Electronic Equipment," issued September 1, 1955.

(b) ARINC Report No. 306, "Guidance for Designers of Airborne Electronic Installations," issued September 1, 1955.

* (c) RTCA Paper 100-45/DO-60, "Environmental Test Procedures - Airborne Radio Equipment," dated April 13, 1954.

* This RTCA report is not available from ARINC, but can be obtained from the Radio Technical Commission for Aeronautics, Building T-5, Room 2036, Sixteenth and Constitution Ave., Washington 25, D. C. Telephone STerling 3-8984.

1.4 Regulatory Approval - To insure provisions for approval of the device, manufacturers should note the usual environmental test requirements outlined in the document referenced in Section 1.3 (c). All applicable CAA Type-Certificate or TSO requirements should be met.

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2.0 Mechanical Considerations

2.1 Weight - The unit should weigh not more than seven ounces. This weight is to include headset and microphone but does not include cable and plug.

2.2 Ear Pieces - The ear pieces should be designed to provide efficient sound coupling without discomfort to the user when worn for extended periods of time. Large sponge rubber caps are not considered suitable. If insertion-type ear pieces are used, they must be easily replaceable and should be attached in such a manner that accidental removal will be unlikely.

2.3 Boom Microphone - The boom should be adjustable to the extent of movement toward or away from the user's face. It should also be pivoted at or near the earpiece so that it may be swung upward out of the way. The locking device on this action should be of a type that will allow the swing-up or swing-down to be made quickly and freely but should provide a positive lock at the up and down positions.

The microphone design should be such as to permit using some form of replaceable vapor shield.

2.4 Cord - The single four-conductor cord should be lightweight type rubber- or plastic-covered for abrasion resistance and cleaning ease. The nominal length should be five feet.

3.0 Electrical Characteristics

3.1 Microphone - The microphone should be of the differential or noise-cancelling dynamic type. Microphone output impedance should be 30 to 50 ohms. The frequency response of the microphone should be flat within plus or minus 3 db from 300 cps to 6000 cps.

Note: The microphone output should be such that when used in conjunction with a transistor pre-amplifier the output level will be of a value equivalent to carbon microphone output. The specific figure for output level will be determined upon later advice from the manufacturers.

3.2 Headset - The headset should have an input impedance of approximately 500 ohms.

3.0 Electrical Characteristics (Continued)

3.3 Plug - A single plug and cord should be provided for the microphone and headset. The plug type should be a Cannon XLR-4-12C straight plug with the following pin connections:

Pin 1 -- Headset
Pin 2 -- Headset
Pin 3 -- Mike - high
Pin 4 -- Mike - return

Note: While the above plug is preferred as the industry standard, there may be a need by some carriers for retrofit aircraft and some other uses, to continue utilizing the commercial equivalents of the PL-55 and PL-68 plugs. For these circumstances, the mike and headset should be available with a single cord, branched approximately 6" from the connector end and the pin connections should be as follows:

Headset - PL-55 standard connections
Mike - PL-68 standard connections:
Mike - Connected between tip and ring
Shield Ground - Connected to sleeve

3.4 Interaction - Interaction between the microphone and headset in the cord should be held to a minimum by suitable shielding techniques.

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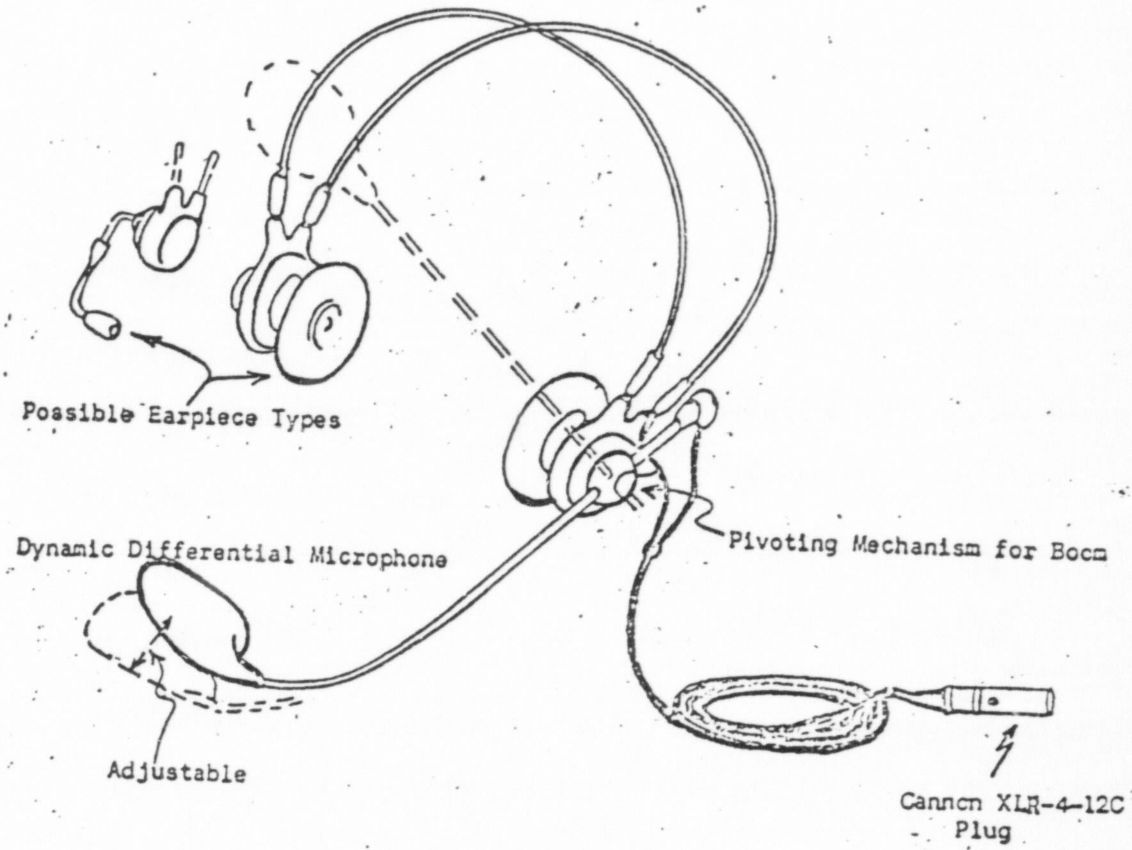
ATTACHMENT I



One Possible Arrangement for Light-Weight Headset and Boom Microphone

ketch Based on
PAA Drawing 707-1

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3.

THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

OCTOBER [illegible]

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A Light-weight Headset for Telephone Operators

H. J. C. SPENCER, A.M.I.E.E., and J. S. P. ROBERTON, B.Sc.(Eng.)†

U.D.C. 621.395.623.64:621.395.722

A new headset for telephone operators has been developed which not only has a superior performance to the head-and-breast set, but is considerably lighter and more comfortable to wear. Unlike the head-and-breast set, the new instrument does not suffer from the disadvantage that the transmitter mouthpiece cannot follow the wearer's mouth as the head turns. This improvement results from the transmitter being mounted next to the receiver in a common housing worn on the ear, a light horn being used to feed speech from the mouth to the transmitter.

INTRODUCTION

FOR very many years the head-and-breast-set type of operators' telephone has been used in the Post Office. Instruments of this type suffer from the fundamental disadvantage that the mouthpiece of the transmitter does not follow the wearer's mouth as the head turns. As a result, unless the wearer makes a conscious effort always to speak into the mouthpiece, sending efficiency may be seriously degraded. This is illustrated by the curves of Fig. 1, which show how the output decreases as the distance of the mouthpiece from the user's mouth increases. In addition, head-and-

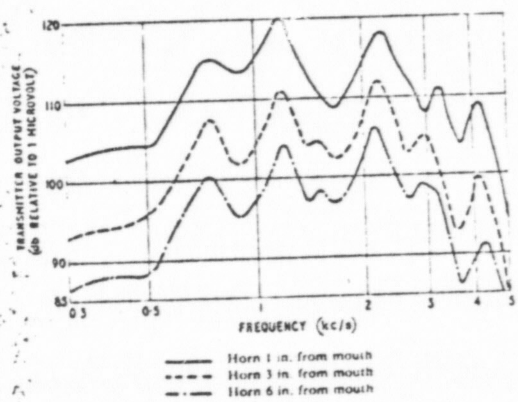

FIG. 1—BREAST-SET TRANSMITTER—VARIATION OF OUTPUT WITH DISTANCE FROM MOUTH

breast sets are unpopular with operators because they are cumbersome to wear. The particular set used by the Post Office has the further disadvantages of being rather heavy and of having a poor transmission performance compared with that of the new type of table telephone.[1] This poor transmission performance is no disadvantage for public exchange use, because of the operator's favourable position in the line network, but it would present problems if the headset were used at private branch exchanges (P.B.X.s) working on the recently extended transmission limits for local line networks.[2] Because of these disadvantages the Post Office has now developed, in co-operation with the telephone manufacturers, a light-weight one-piece headset to supersede the head-and-breast set, and the process of completely replacing the old instruments by the new has commenced. The new instrument is illustrated in Fig. 2.

THE NEW HEADSET

As a preliminary to work on a new design, user trials were made of a one-piece instrument for which the now conventional practice was followed of putting the transmitter at the end of a boom projecting from the receiver (a practice pioneered in this country in 1933 by Standard Telephones and Cables, Ltd.). The trials showed that the concentration of transmitter weight at the end of the boom resulted in an unstable arrangement, and for the new headset an alternative solution has been adopted; namely, to mount the transmitter next to the receiver in a common moulded housing worn on the ear. Speech is fed to the transmitter from the mouth by a light horn. The advantages of this novel form of construction compared with the use of a transmitter supported on a boom are:

(*a*) A better balance is achieved, giving increased stability with lower headband pressure.

(*b*) Operators naturally like the obstacle in front of

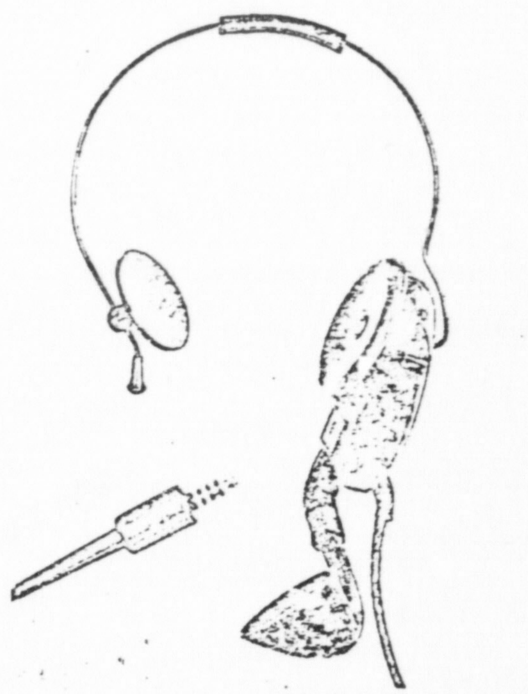

FIG. 2—THE NEW HEADSET

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the lips to be as small as possible. For a given size of obstacle greater sending efficiency is obtained because the whole mouth area of a horn is fully effective, whereas, because its edge is clamped, only part of the area of a transmitter diaphragm is completely effective.

(c) A horn has a slight directional effect which increases with frequency, and this gives some discrimination against undesirable ambient noise.

(d) Cord arrangements are simplified. A 4-way cord enters the set through a single hole and is connected directly to the transmitter and receiver. There is no need for a separate cord to the transmitter; such a cord would involve additional series connexions and could get tangled with other parts of the set.

(e) The transmitter is much less vulnerable to mechanical damage.

(f) The arrangement is more hygienic because the horn can easily be removed and cleaned. It can also be immersed in disinfectant, which would not be possible with a complete transmitter.

(g) The overall design of the set is cleaner, giving fewer awkward traps for hair, and adjustment to suit the head of the wearer can be made naturally while the set is on the head.

The new headset is designed to combine lightness with strength and resilience so that it can withstand mechanical shocks in service. This combination is achieved largely by the use of nylon and other resilient plastics for the mouldings. Nylon has quite a good surface finish, and its toughness and shock resistance give almost unbreakable mouldings. The strength of nylon has allowed thin sections to be used to reduce weight. The total weight of the headset, less plug and cord, is under 5 ounces, which is less than the weight of the receiver alone of the earlier instrument and less than one third of the weight of the complete head-and-breast set. An important feature which contributes to the shock resistance of the headset is the provision of a springy joint at the "elbow" that joins the horn to the body of the set. This joint is often a region of weakness in headsets with transmitters supported on a boom. In addition, the use of flexible plastic gaskets at the joints of the various parts of the acoustic system and the provision of springs for holding the transmitter and receiver capsules in place both contribute to the shock resistance.

Apart from its toughness, nylon is a very suitable material because of the absence of harmful effects to the skin through contact with it; it is, in fact, frequently used in surgery for inclusion within the human body.

A small but useful detail in the body moulding is a frame in which an identifying label may be fixed.

Transmitter and Associated Acoustic System

The transmitter is a miniature carbon-granule sealed capsule designed specifically for use in the headset. It is illustrated in section in Fig. 3. The electrodes of the transmitter are parts of concentric spheres; this shape, combined with a very small carbon charge, makes the transmitter sensitive and reasonably free of amplitude distortion, as may be seen from Fig. 4, which shows sensitivity/frequency curves for three different sound pressures. The electrodes are made from brass plated with gold; the front electrode is fixed to the light alloy diaphragm and the parts are assembled in a die-cast aluminium frame. The charge of carbon granules is

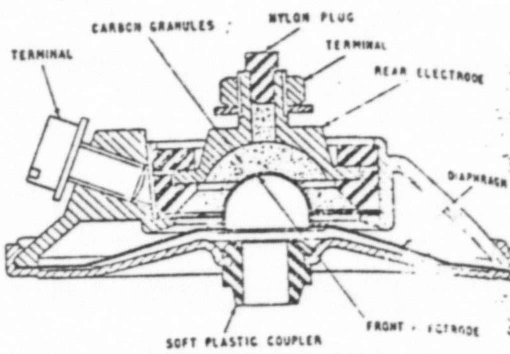

FIG. 3—CROSS-SECTION OF TRANSMITTER

inserted through a hole in the rear electrode terminal, which is then closed with a tight-fitting nylon plug. As the transmitter is designed to be pressure-operated in conjunction with the horn of the headset, the volume of air in front of the diaphragm is reduced by the front cover of the transmitter being designed so that it follows closely the diaphragm contour. The transmitter is sealed to the acoustic tube in the headset by a soft p.v.c. coupler, which is captive in the transmitter front cover.

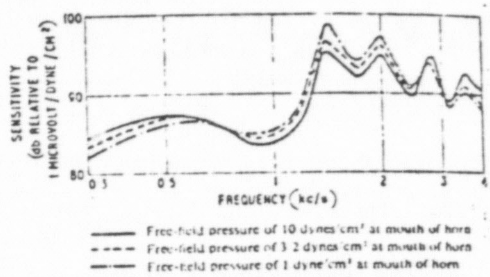

FIG. 4—VARIATION IN SENSITIVITY WITH SOUND LEVEL

The acoustic system consists of the parts shown in Fig. 5. It is designed to allow the horn to take up alternative positions so that the headset may be worn on either ear, and there is a cone of free movement of the horn about each position to cater for variations in head shapes. The parts are assembled with the helical spring passing through them and in tension between a die-cast anchor at the set end and a washer at the horn end. This keeps the joints in the system in compression, so giving good sealing. Sealing at the joints is assisted by resilient polythene washers, the washer between the ball and elbow being conical in shape. The sealing is also improved by care in moulding to obtain close fitting surfaces between the elbow and the headset body. The tension of the spring also ensures a secure connexion between the horn and the headset.

The horn is exponential in shape, i.e. its cross-sectional area at a point distance x cm from the throat is related to the area at the throat by the equation

$$S_x = S_0 \exp mx$$

S_0 and S_x are the areas (cm²) at the throat and at x respectively, and m (per cm) is known as the flaring constant.

The action of the horn can be likened to that of an

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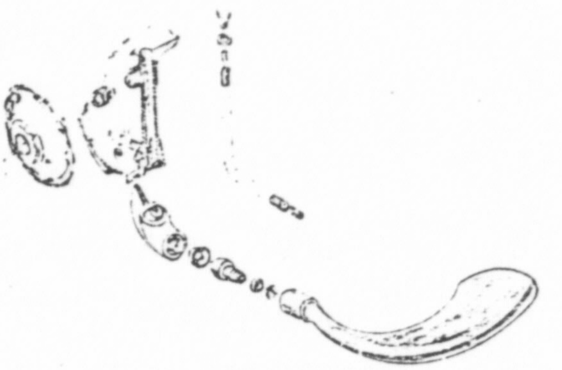

FIG. 5—THE ACOUSTIC SYSTEM

electrical transformer; large air movements with low pressures at the mouth of the horn are converted to small air movements with high pressures at the throat. The small air movements make it unnecessary to have an acoustic channel with a large cross-section, but the high pressures do require the sealing of the channel to be good. Exponential horns have the property of transmitting sound waves efficiently down to a frequency determined by their dimensions. Below this frequency, given by the equation $f_{co}=(mc)/(4\pi)$ where c is the velocity of air in cm/sec and m is the flaring constant already referred to, the horn transmits the sound waves with progressively greater loss, thus acting as a high-pass filter. This property has been used in the headset to equalize to some extent the frequency response of the transmitter. The carbon-granule transmitter has one main resonance, just below 1,200 c/s, controlled largely by the mass and stiffness of the diaphragm and front electrode. If used alone the transmitter would have a peaked response. The horn dimensions have, however, been chosen so that the cut-off frequency is just above the peak of the response of the transmitter alone. This peak is therefore reduced, and the response of the combination is maintained reasonably constant up to a frequency of 4,000 c/s.

A subsidiary function of the helical spring in the acoustic channel is to reduce peaks and troughs in the transmission characteristics of the horn. These occur because the horn is of finite length and is not matched acoustically to free air, so that reflections take place from the open end. These emphasize some frequencies and attenuate others. The presence of the spring more than doubles the surface area within the channel and the consequent acoustic damping reduces the difference between peaks and troughs from 12 db to 5 db, which is tolerable. Below its cut-off frequency the horn behaves as a sound conduit having a rather high acoustic mass. This mass resonates with the acoustic stiffness of the volume of air between the inside of the front of the transmitter and the diaphragm at a frequency of about 500 c/s. This resonant peak is also adequately damped by the presence of the spring in the acoustic channel.

Receiver

The receiver is a miniature version of the rocking-armature receiver,[a] and has been developed specially for the headset. The magnetic drive-unit of the new receiver is identical with that in the larger one, but size and weight have been reduced by using a smaller diaphragm and by omission from the receiver capsule of some of the acoustic equalization structure. Retention of the same magnetic unit has made it necessary to drive the smaller diaphragm off-centre; this has had the beneficial effect of increasing the effective portion of its area so that the loss in efficiency caused by the reduction in size is less than it would otherwise be. The acoustic equalizing volume and the outlet holes are omitted from the receiver capsule and are formed instead in the moulded earpiece, to which the capsule is sealed by a resilient rubber ring.

A housing for the receiver only of the headset is available. Two receivers may be joined by a common headband to form a double-receiver headgear, and there is also a version of the headset which has a second receiver. By the use of appropriate cords a pair of receivers may be coupled in series or in parallel, or they may be connected to separate circuits. A range of receivers having different impedances is available.

Headband

After trials of a number of different designs, the double-pad headband, shown in Fig. 2, was found to give the greatest comfort and stability, being based on support at three points, the earpiece, the top head-pad and the side head-pad. The pads are made from a soft lead-free grade of p.v.c. Since each is a tight sliding-fit on the headband wire, the pads may be adjusted to the best position for comfort and balance for each wearer. The hard-drawn steel wire is covered with shrunk-on p.v.c. sleeving and may be bent slightly to suit the needs of individual wearers. Soldered to the instrument end of the wire is a phosphor-bronze ball which is gripped in a spring-loaded socket in the headset cover. This ball-joint, while allowing easy adjustment of the angle of the wire to the set, is stiff enough to add stability while the headset is being worn. The free end of the headband wire is guarded with a screw-on nylon ferrule.

Plugs and Cords

To match the light weight of the new headset the Post Office has adopted a new miniature 4-way plug. The plug follows the general form of its predecessor, but improvements in detail and the use of nylon for the moulding material result in its being much more robust and reliable in spite of its reduced size.

The cords used for the new headset have p.v.c. insulation with a nylon outer braiding and are round in cross-section. Particular attention has been paid to relieving the cord terminations of strain. At the plug end of the cord the strains are taken by a long protective sleeve which is too large to pull through the hole in the plug cover. At the headset end, the strains are taken by a grommet moulded on the cord. The grommet is curved to let the cord fall away from the set naturally and is square in cross-section, where it engages the headset, to prevent twisting.

PERFORMANCE

Sending Efficiency

The output/frequency characteristics of the new headset and the old breast-set transmitters are shown in Fig 6. The output of the headset is shown for a feeding current of 40 mA, while the breast-set transmitter output is shown for 120 mA, this being its normal operating condition. It will be seen that, even at the much lower current, the new headset has an output equal to that of the breast set. Where the

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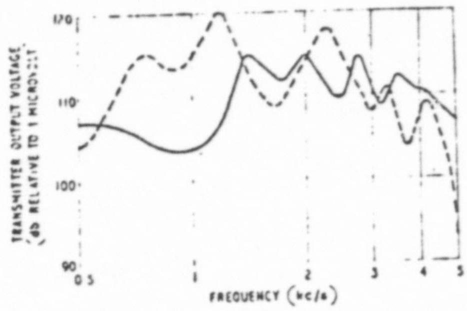


——— New headset (40 mA transmitter current)
– – – – Breast set (100 mA transmitter current)

Speaking distance 1 in.: free-field sound pressure 10 dynes/cm² at 1 in. from mouth

FIG. 6—TRANSMITTER OUTPUT/FREQUENCY CHARACTERISTIC

maximum performance is not required, therefore, it is possible to reduce the feed-current below 120 mA. This has a number of advantages:

(*a*) The life of the transmitter is increased (at 120 mA the life of the new transmitter is equal to that of the transmitter in the breast set).

(*b*) The heat dissipated in the transmitter is reduced. Because the transmitter is carried on the head any heat from the transmitter might be noticeable, but the effect is negligible at 40 mA.

(*c*) Power requirements are reduced. There are some subscribers' installations in which the major power requirement is for the operators' transmitters. Worth-while economies can be realized at such installations.

Receiving Efficiency

The sensitivity/frequency characteristics of the receiver in the new headset and the receiver in the head-and-breast set are given in Fig. 7. They show that the new receiver is approximately 7 db more sensitive than the old and has a superior frequency response. The new receiver shares with the larger rocking-armature receiver the advantage that its acoustic output-impedance is low, so that reduction in sound pressure at the ear by leakage between ear and earpiece is minimized.

INTRODUCTORY PROBLEMS

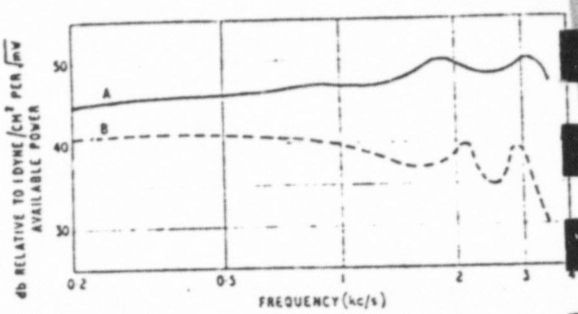
It has not been possible to use the new headset as a direct replacement for the old, firstly because of the smaller plug used with it, and secondly because in the majority of Post Office applications its superior performance is actually an embarrassment. The following changes, made to the operator's position circuit at sleeve-control exchanges, are typical of those made when the headsets are introduced:

(*a*) All jacks are changed to suit the new plugs.

(*b*) An additional 820-ohm resistor is inserted in the d.c. feed to the transmitter. This reduces the current to about 40 mA, at which the sending efficiency is the optimum for this application.

(*c*) A 150-ohm resistor is fitted within the headset, shunting the receiver and reducing receiving efficiency by about 4 db.

It was necessary to connect the receiver shunt within the headset, rather than in the switchboard, because for an interim period the old-type handsets with 2P receivers will continue to be used on the same switchboard positions and with this type of telephone the shunt would



A Receiver of new headset
B Receiver of old-type set

FIG. 7—RECEIVER SENSITIVITY/FREQUENCY CHARACTERISTIC

cause a reduction of receiving efficiency which would not be tolerable. The handset transmitter is sufficiently sensitive, however, to make the reduction of efficiency caused by the lower feed-current, acceptable.

Even with these changes, the overall sensitivities of the new headset are considerably greater than those of the old and there were fears that this would cause complaints of excessive sidetone. Field trials in telephone exchanges showed that these fears were, however, unfounded. A factor contributing to this was the marked reduction in switch-room noise levels which accompanied a change to the new headset, due to the lower level at which operators found it necessary to speak. If only some instruments had been changed, or if background noise were high for other reasons, the result might not have been so favourable.

For P.B.X. use advantage can be taken of some, and often all, of the additional sensitivities of the headset. For these uses the values of the transmitter feed-current and the receiver shunt are adjusted to give the sending and receiving efficiencies required. In some P.B.X. circuits changes are also made to the balance circuit to reduce sidetone.

CONCLUSIONS

A new headset has been designed which is much lighter and more comfortable to wear than the old head-and-breast set. It has been enthusiastically welcomed by telephone operators. In spite of its small size and low weight, the headset is very robust, and extensive field trials have proved it to be a very reliable instrument.

The transmission performance of the new headset is markedly superior to its predecessor, both in sensitivity and frequency response. Its use enables the transmission performance of P.B.X. switchboard operators' instruments to be maintained with the recently extended transmission limits for local line networks.

ACKNOWLEDGEMENT

The headset has been developed for the Post Office by Standard Telephones and Cables, Ltd., under the British Telephone Technical Development Committee procedure.

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776,896 3 SHEETS COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale. SHEET 1

FIG. 1.

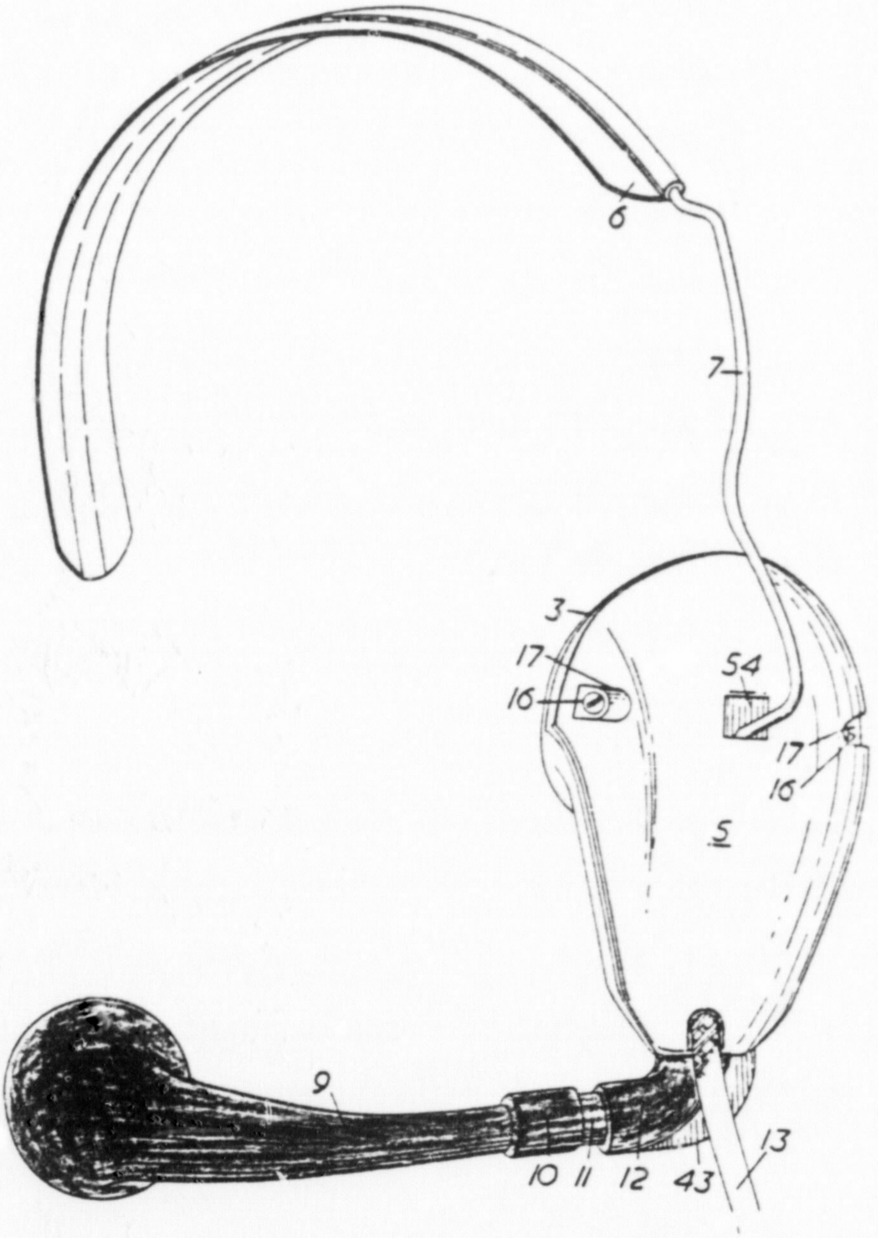

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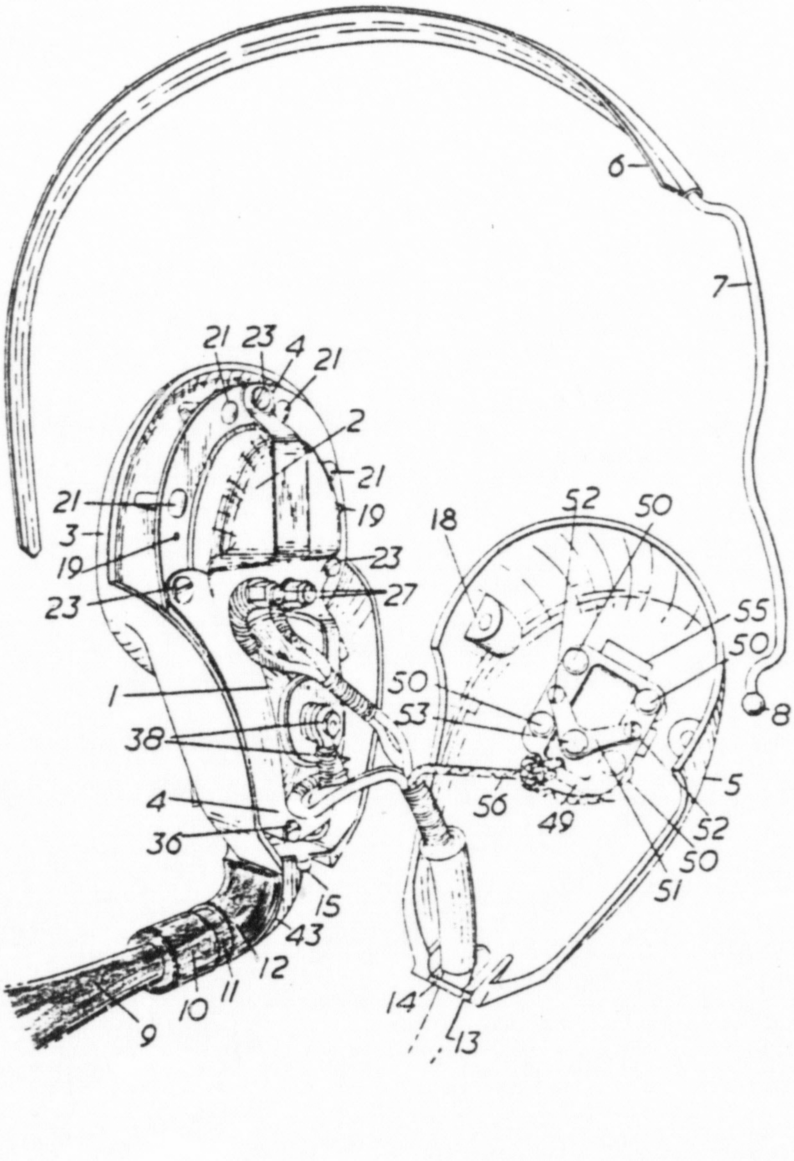
FIG. 2.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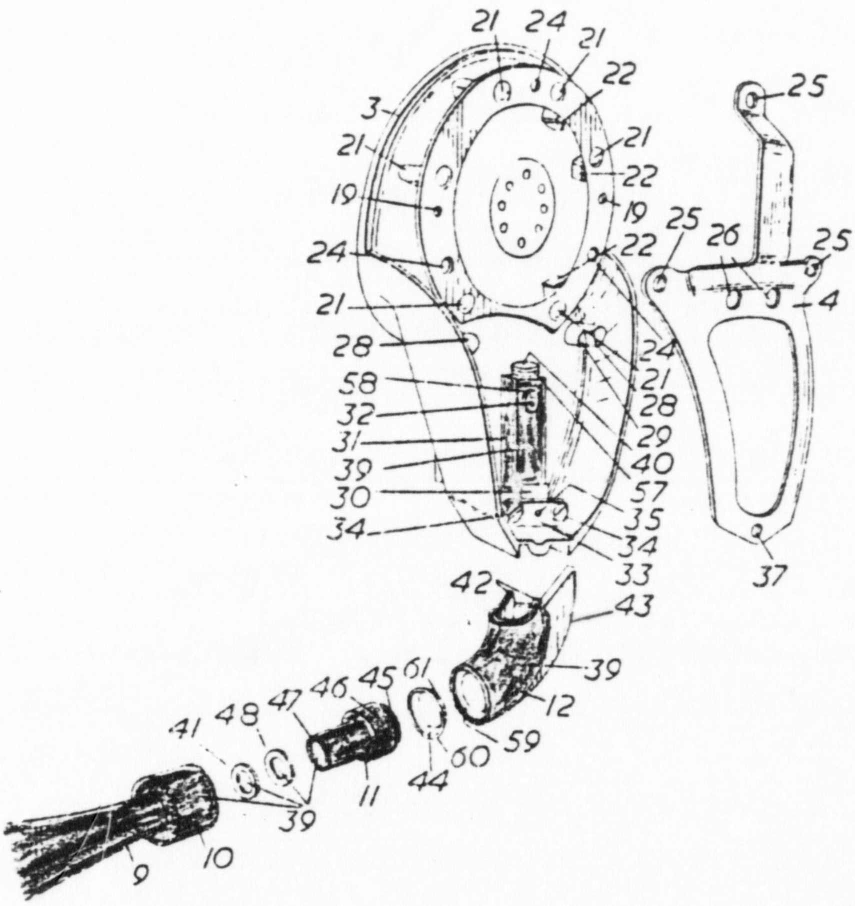
776,896 COMPLETE SPECIFICATION
3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEETS 2 & 3

FIG. 3.



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PATENT SPECIFICATION

Inventor: JAMES SAMUEL PATERSON ROBERTSON

776,896

Date of Application and filing Complete Specification April 29, 1955.

No. 12509/55.

Complete Specification Published June 12, 1957.

Index at acceptance:—Classes 13, 13(C: G); and 40(4), J(1A: 1B: 3A: 3E: 3R: 4B: 4D).

International Classification:—C10k. H04m.

COMPLETE SPECIFICATION

Improvements in or relating to Operator's Telephone Headsets

We, STANDARD TELEPHONES AND CABLES LIMITED, a British Company, of Connaught House, 63 Aldwych, London, W.C.2, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to operators' telephone headsets. According to one aspect of the invention, there is provided an operator's telephone headset comprising an acoustic wave transmission column which is adapted to pass acoustic waves from the mouth towards a telephone transmitter carried by a headband, and which includes a detachable and rotatable horn carried by the transmitter casing.

According to another aspect of the invention, there is provided an operator's telephone headset comprising an acoustic wave transmission column for passing acoustic waves from the atmosphere towards the telephone transmitter which is carried by a headband, the column including a curved horn terminating at its smaller end in a cylindrical collar, which forms a push-fit with a cylindrical connecting-piece terminating an acoustic channel extending from the transmitter casing. The cylindrical collar being capable of rotation on the connecting-piece.

The invention will now be described with reference to the accompanying drawings in which:—

Fig. 1 is a general view of the set,

Fig. 2 shows the set partly dismantled,

Fig. 3 shows parts of the set after further dismantling.

Referring to Figs. 1—3, the transmitter assembly 1 and the receiver assembly 2 are carried by a base 3 and held in position by a flexible strap 4. A cover 5 encloses both assemblies. A pad 6 is carried by a headband 7 mounted by means of a ball 8 on the cover 5. An exponential horn 9 terminates in a collar 10 mounted on a connecting piece 11. The connecting piece 11 is adjustably mounted on an angle-piece 12 which is rotatably mounted on the base 3. The leads to the transmitter and receiver are carried in a cord 13 which passes through an aperture in the cover 5.

The angle piece 12 can be rotated through 180° from the position shown in the drawings. The collar 10 of the horn 9 can rotate around the connecting piece 11. By rotating the angle piece 12 and the horn 9 through 180° the set may be worn with equal convenience on either ear. The connecting piece 11 engages the angle-piece 12 in a flexible joint which permits the position of the horn 9 to be adjusted to suit the user. A ball-and-socket joint is used to connect the headband 7 to the cover 5 at the aperture 54. The connection at this joint is therefore also adjustable. The angle piece 12 is mounted on the base 3 below the receiver assembly 2. By moving the base 3 pendulum fashion about the ball-and-socket joint, the angle-piece 12 can be moved forward of or behind a vertical line passing through the centre of the receiver assembly 2. In this way the set can be adjusted to suit the distance between the ear and the mouth of any particular user.

The cover 5 is held to the base 3 by a lug 14, which engages with a stud 15, and by two screws 16. The head of each screw 16 is accommodated in a recess 17 on the outer surface of the cover 5. The shank of the screw 16 is held by a pillar 18 embossed on the inner surface of the cover 5. Each screw 16 engages with a hole 19 tapped in a ring 20, which is attached to the base 3 by a number of studs 21. The heads of the studs 21 are expanded rivet-fashion to hold the ring 20.

The studs 21 have a ledge 22 on the inner surface. The receiver assembly 2 rests on these ledges. The receiver assembly 2 is held in position by the flexible strap 4 which is secured to the ring 20 by three screws 23 engaging in tapped holes 24. Holes 25 in the strap 4 permit the passage of the screws 23. Two further holes 26 permit the terminals 27 of the receiver assembly 2 to pass through the strap 4.

[*Price 3s. 6d.*]

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To carry the transmitter assembly 1, two pillars 28, each with a ledge 29, are provided on the base 3. A third ledge 30 is also provided for this purpose. The ledge 30 is part of the outer surface of a hollow column 31 which is formed integrally with the base 3. The hollow core of the column 31 acts as part of the acoustic channel 39 leading from the horn 9. A hole 32 is provided in the column 31 at a position which is suited to the position of the microphone in the transmitter assembly 1. The hole 32 is surrounded by a rim 58 which serves as a seating for a polyvinylchloride washer (not shown) or similar resilient member which ensures an acoustically tight joint, when the transmitter assembly is in position. At the foot of the column 31, an inset 33 is held by two screws 34, the heads of which are expanded rivet-fashion. The inset 33 carries a tapped hole 35. The transmitter assembly 1 is held in position by the strap 4, the lower portion of which is secured by a screw 36 which passes through a hole 37 in the strap 4 to engage in the tapped hole 35 of the inset 33. When the screw 36 is tight, the strap 4 holds the transmitter assembly 1 with sufficient force to ensure a substantially acoustically tight joint at the hole 32. To assist in making a tight joint, a washer (not shown) is provided at the hole 32. To isolate the transmitter assembly acoustically from the base 3, the transmitter assembly carries an annular cushion (not shown) which bears on the ledges 29, 30. The transmitter assembly 1 has two terminals 38 to which the cord 13 is connected.

By undoing the appropriate screws 23, 36, the transmitter assembly 1 and the receiver assembly 2 can be removed from the base 3 independently of each other.

The horn 9 is connected to the base 3 by the connecting piece 11 and the angle-piece 12. Each piece has a hollow central bore forming part of acoustic channel 39 connecting the horn 9 to the microphone of thr transmitter assembly 1. The connecting piece 11 and the angle-piece 12 are held in their working positions by a helical spring (not shown) which is accommodated within the acoustic channel 39. One end of the spring is anchored to a cap 40 provided at the top of the column 31, a polythene washer 57 being provided between the cap 40 and the column 31 to ensure an acoustically tight joint. The other end of the spring is anchored to a washer 41 at the outer end of the connecting piece 11. The tension of the spring keeps the connecting piece 11 and the angle-piece 12 in position. Within the angle-piece 12, the acoustic channel 39 is composed on straight bores. If a uniformly curved bore is used, the spring acquires a bias resulting in an uneven action of the joint between the connecting piece 11 and the angle-piece 12 and in a reduction of pressure at one side of the joint between the angle-piece 12 and the base 3 to a value insufficient to keep the joint acoustically tight. The horn 9 is held in position by the friction between its collar 10 and the connecting piece 11 which the collar 10 fits closely. The presence of the spring within the acoustic channel 39 gives rise to acoustic damping and reduces the amplitude of standing waves which occur at certain frequencies.

The bearing surface of the angle-piece 12 against the base is provided with two cams 42 set 180° apart. The cams 42 engages with two recesses (not shown) provided at the foot of the column 31 in the base 3. The angle-piece 12 has therefore two stable positions, 180° apart, in relation to the base 3, in each of which the cams 42 engage in the recesses. A small clearance is allowed between the tops of the cams 42 and the bottoms of the recesses. This ensures that the pull-action of the spring is taken by the main bearing surfaces of the angle-piece 12 and of the base 3 so as to secure a substantially acoustically tight joint. The angle-piece 12 is provided with a fin 43, which comes into contact with the outer surface of the base 3 if an attempt is made to rotate of the angle-piece 12 beyond 180° from the position shown in the drawings. The face of the fin 43 which comes into contact with the surface of the base 3 is so inclined that, if rotation is continued beyond 180°, the angle-piece 12 is forced downward against the action of the helical spring in the acoustic channel 39. The check action thereby obtained is gradual and less likely to give rise to breakages than the positive action of a buffer stop. The check action also serves to discourage continuous rotation of the angle-piece 12 in one direction and to prevent the deleterious effect on the spring which such rotation would have.

The other end of the angle-piece 12, is indented to provide a seating 59 for a polythene washer 60. The seating 59 and the outer surface 61 of the washer 60 are in the shape of the frustrum of a cone. The inner surface 44 of the washer 60 is part of a sphere.

Under the influence of the helical spring, the connecting piece 11 beds against the surface 44 of the washer 60 and provides a substantially acoustically tight joint between the angle-piece 12 and the connecting piece 11.

At one end of the connecting piece 11 is a surface 45 which bears on the surface 44 of the washer 60. The surface 45 is formed from a hemisphere, part of which is cut away for the acoustic channel 39. The joint between the connecting piece 11 and the angle-piece 12 can therefore function as a ball-and-socket joint while remaining substantially acoustically tight. The angle of the horn 9, which depends on the position of the connecting piece 11, can therefore be varied without impairing the efficiency of the acoustic channel 39.

The surface 45 terminates in a shoulder 46. At the other end of the connecting piece 11 is a flat bearing surface 47 for the polythene washer 48, which is held in position by the

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action of the spring (not shown) on the washer 41.

The exponential horn 9 is made of nylon which will regain its shape after accidental deformation. The shape of the horn 9 is determined by the type of microphone used in the transmitter assembly 1 and is such as to give increasing efficiency above the frequency at which the efficiency of the mircophone begins to decrease. The horn 9 has a collar 10 enclosing a hollow brass inset which fits on to the connecting piece 11 and abuts the shoulder 46. The collar 10 and the connecting-piece 11 are dimensioned to give a push-fit. The action of the spring tends to make the connecting-piece 11 barrel shaped and so ensures adequate frictional contact. The joint is made acoustically tight by the washer 48.

The washers 48, 57 and 60 are made of polythene which has approximately the same coefficient of friction under static and moving conditions. The position of the horn 9 can therefore be varied without jerks.

On the inside of the cover 5 an inset 49, in the shape of a hollow square is carried by four studs 50, the heads of which are expanded rivet-fashion. A V-piece 51 is carried on the inset 49 by two screws 52. At the apex of the V is a socket 53 which receives the ball 8 of the headband 7 which penetrates the cover 5 at the aperture 54. The V-piece 51 is resilient and forces the ball 8 into contact with another socket (not shown) on the inner surface of the cover 5. The inset 49 clamps a piece of soft material 55 against the inner surface of the cover 5. The piece of soft material 55 prevents the entry of dust through the aperture 54. A short length of fine cord 56 is tied at one end to the inset 49 and at the other end to the cord 13, to act as a stain cord.

By using the construction described above, it is possible to effect an appreciable reduction in the weight of the operator's telephone headset. While conventional sets may weigh as much as 15½ ozs, a set constructed as described above weighs only 4 ozs.

What we claim is:—

1. An operator's telephone headset comprising an acoustic wave transmission column which is adapted to pass acoustic waves from the mouth towards a telephone transmitter carried by a headband and which includes a detachable and rotatable horn carried by the transmitter casing.

2. An operator's telephone headset comprising an acoustic wave transmission column, for passing acoustic waves from the atmosphere towards the telephone transmitter which is carried by a headband, the column including a curved horn terminating at its smaller end in a cylindrical collar, which forms a push-fit with a cylindrical connecting-piece terminating an acoustic channel extending from the transmitter casing, the cylindrical collar being capable of rotation on the connecting-piece.

3. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 2, wherein the cylindrical connecting-piece is carried by an angle-piece, is separate from the transmitter casing, and is carried thereby and held thereto by a helical spring which passes through the connecting-piece, the angle-piece and a passage in the transmitter casing, and which is anchored at both ends.

4. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 3, wherein the angle-piece terminates in cam-extensions, which engage in complementary cam-recesses at the end of the passage in the transmitter casing; so that the knee-joint can be rotated between two positions 180° apart, in each of which positions the cam-extensions and the cam-recesses are in engagement, movement between said positions being possible by rotating said angle-piece around the axis of said passage in the transmitter casing and disengaging said cam-extensions and cam-recesses during rotation.

5. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 3, wherein the angle-piece carries a fin having an inclined face so sloped as to oppose rotation of the angle-piece between said two positions via one half-circle, and thereby to prevent the internal helical spring being continuously wound in the same direction.

6. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 5, wherein the acoustic passage in the angle-piece has a sharp turn to prevent imparting a bias to the helical spring, which would impair the action of the spring.

7. An operator's telephone headset comprising an acoustic wave transmission column as claimed in any of Claims 3—6, wherein the cylindrical connecting-piece has a rounded termination at one end, said termination engaging a co-operating recess at the end of the angle-piece, to form a ball and socket joint.

8. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 7, wherein the other end of the cylindrical connecting-piece carriers a resilient washer, held in place and compressed by a rigid washer, to which one end of the helical spring in achored, said resilient washer constituting an acoustic seal between the horn collar and the connecting-piece.

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Chartered Patent Agent,
For the Applicants.

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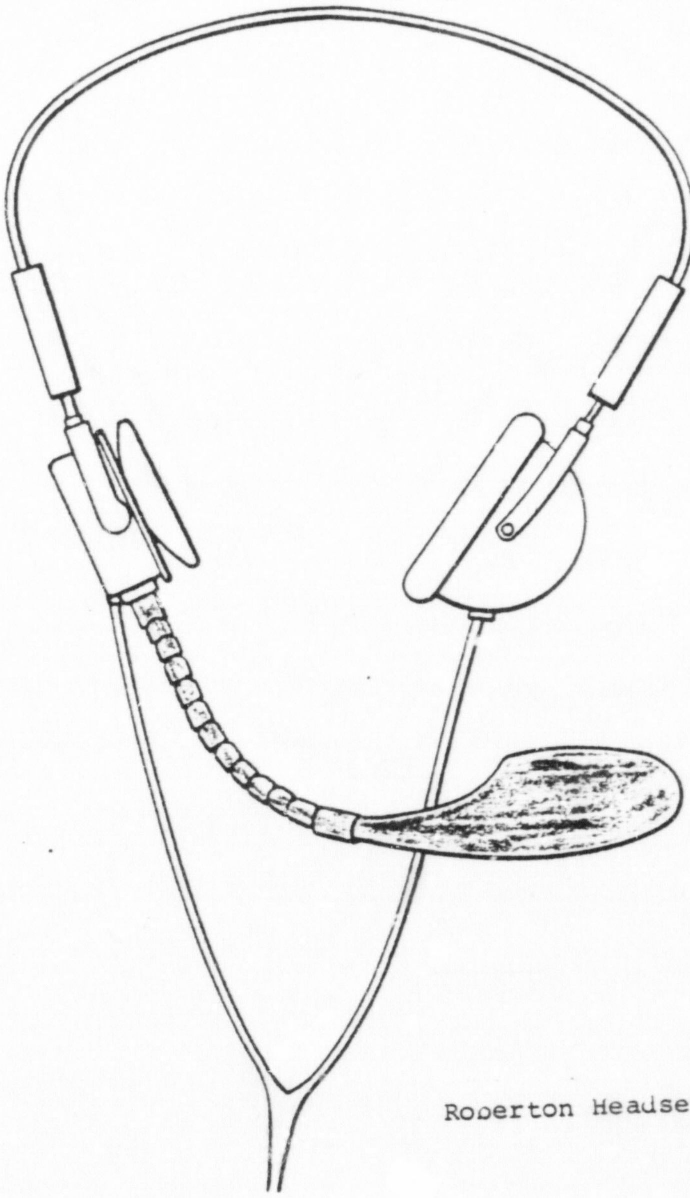
716,801 PROVISIONAL SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

FIG. 4.



Roberton Headset - Ex. C

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FIG. 1.

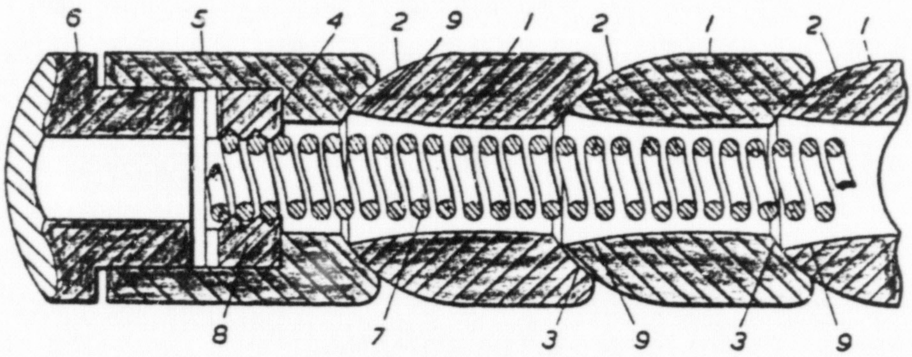


FIG. 2.

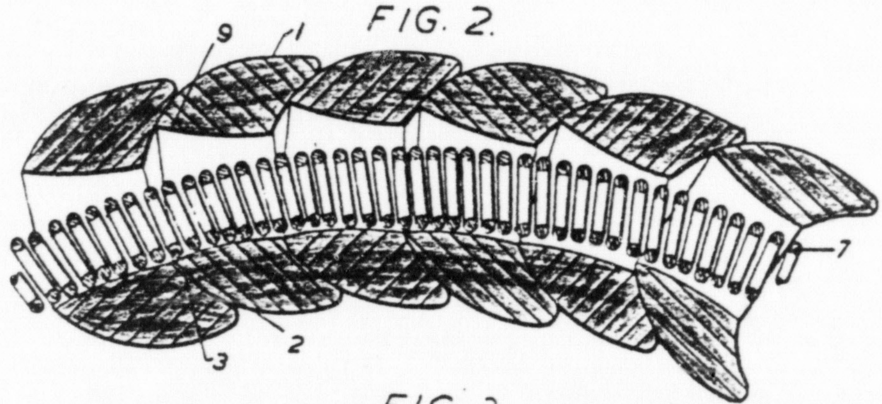
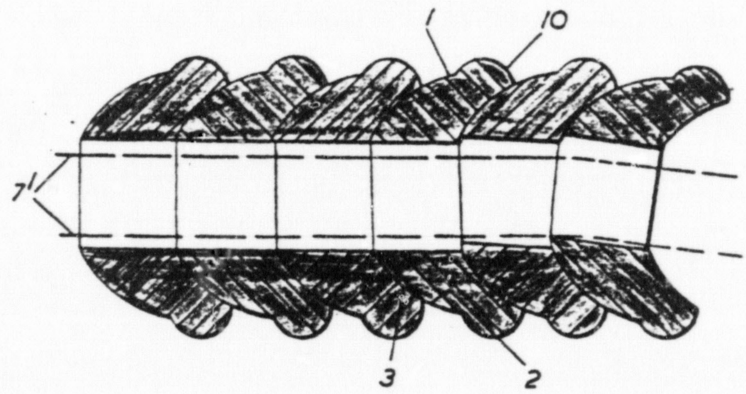


FIG. 3.



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PATENT SPECIFICATION

Inventors: JAMES SAMUEL PATERSON ROBERTSON and EDWIN JOHN SHELTON

716,801

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COMPLETE SPECIFICATION

Acoustic Duct for Electro-Acoustic Transducer

We, STANDARD TELEPHONES AND CABLES LIMITED, a British Company, of Connaught House, 63 Aldwych, London, W.C.2, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to acoustic devices comprising acoustic ducts.

According to the invention there is provided an acoustic device comprising a flexible acoustic duct incorporating a plurality of identical unitary hollow nesting segments, contiguous surfaces of which are shaped so as to maintain continuous annular contact between adjacent segments over a predetermined range of relative movement of adjacent segments with means passing through the duct for maintaining the segments in axial compression one against another.

It is frequently required to operate an electroacoustic transducer at some little distance from the origin of the sounds or the place where the sound is to be delivered according to whether the transducer is of the microphone or the receiver type, and it is proposed to use a flexible duct for the purpose.

Flexible metallic tubing of the ordinary type may be used, but is inclined to be heavy, especially when it is of the "stay put" type which will retain the form into which it is bent.

It has been found that a tube made up of separate nesting segments, held together by the endwise tension of a spring or the like has many advantages as an acoustic duct.

The invention will be described in relation to certain embodiments developed for use with a telephone operator's headset where it is proposed to mount the microphone on the head band and to provide an adjustable acoustic duct terminated by a small mouthpiece for sound transfer from the mouth to the microphone. These embodiments are illustrated in the drawings accompanying the provisional specification in which:—

Fig. 1 shows a longitudinal cross section of a duct of segmented type with one kind of segment, and shows the method of securing an internal tensioning spring;

Fig. 2 shows a longitudinal cross section of a part of a duct of segmented type using another kind of segment.

Fig. 3 shows a longitudinal cross section of a duct of segmented type using yet another kind of segment; and

Fig. 4 shows a telephone operator's head-set using a duct of the type illustrated in Fig. 1 for conveying speech from the operator's mouth to a microphone secured against the head.

In Fig. 1 a segmental duct is made of a number of hollow cylindrical segments each having one end 2 shaped to the form of a part of a convex sphere and the other end 3 hollowed out in the shape of part of a concave sphere. The convex end of one segment nests into the concave end of the next one and all are held together by a coiled spring 7 running down the central bore of the segments and secured at each end by a nut 8 threaded internally to grip the convolutions of the spring and bearing against an internal shoulder 4 of a special end piece 5 which may be bored out to form a socket for attachment of the transducer at one end or the sound outlet or collector at the other end. The figure shows part of a ferrule 6 fitting into 5 for such attachments. The nesting faces of the segments permit movement in directions normal to the axes of the segments, the segments swivelling in relation to one another within limits set by the internal spring which arrests further movement when it bears against one segment at one side and the adjoining segment at the diametrically opposite

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side, in the region of the junction between two segments.

To allow the maximum flexibility, the internal bores of the segments may be widened at one or both ends as shown at 9.

The greater the tension of the spring 8, the greater the friction between nesting faces of adjacent segments and the better does the duct retain the shape into which it is bent.

Fig. 2 shows a part of a segmented duct using axially shorter segments which enable smoother bends to be made. Corresponding items in the figure and in Figs. 1 and 3 are given the same reference numerals.

In Fig. 3 segments even shorter than those of Fig. 2 are shown and in addition each segment has a circumferential rib 10 at the concave end which stiffens this end to resist any tendency for it to open out under the endwise pressure of the spring forcing the convex end of the adjacent segment into it. The rib also limits the bending movement of segments relative to one another which has certain advantages when sharp bends are made since any tendency for one pair of segments to take more than its fair share of the angular displacement is resisted.

The shorter the segments, the less tendency there is to trap the spring and the opening of the ends of the bores of the segments may be omitted. As there is also less tendency for the trapping of the spring to limit the relative movement of the segments, it is sometimes necessary to have ribs such as 10, for this reason alone.

The relative movement of segments must not be allowed to reach the point at which the bore of one segment is uncovered by the adjacent segment allowing the duct to leak to the surrounding air.

In Fig. 3 the spring 7 is shown in outline only by parallel dotted lines 7'.

The acoustic characteristics of acoustic ducts are such that sounds passing down them are subjected to amplitude frequency distortion, that is to say some frequencies are boosted and others attenuated. This effect grows with a shortening of the duct and *vice versa*.

When, for any length of duct, this distortion cannot be tolerated it may be considerably minimised by introducing acoustic resistance into the duct.

When ordinary flexible stay-put tubing is used for the duct, resistance may be introduced into the bore in a variety of ways such as packing with wadding or inserting a roll of fine gauze. If wire gauze is used the flexibility of the tube is somewhat impaired and the gauze must be placed where sharp bends are not required.

It has been found in the case of segmented ducts of the type shown in Figs. 1, 2 and 3, that this resistance can be furnished by the spring 7 if it is of the correct form.

The best results are obtained if the spring is smaller in over-all diameter than the internal bore of the segments so that air waves pass along the spring inside and outside. The closer the coils of the spring, the greater the resistance so long as they are not actually touching one another. The resistance is caused by skin friction of the air in passing over the surface of the spring coils and anything which increases the area of this surface increases the acoustic resistance.

It is known, in an operator's headset to use a miniature microphone mounted on an adjustable boom secured to the receiver or to the end of the head harness opposite to the one to which the receiver is secured. It is difficult with this arrangement to avoid disturbing the adjustment of the boom when the head is moved due to the inertia of the microphone.

It is now proposed to fix the microphone to the head harness and extend the sound inlet by means of a flexible duct terminating in a flare opposite the mouth. Fig. 4 shows this arrangement with a segmented duct.

The duct must be flexible so that it can be adjusted to suit the individual operator and it must be of the "stay-put" type so that it will retain its adjustment. Unless the duct is made of light weight materials, it is liable to lose its adjustment in the same way as the boom-mounted microphone, when the head is moved. Most commercial flexible metallic tubing of the stay-put type is apt to be objectionable on this score and a special lightweight tubing should be used. On the other hand a segmented duct made in the manner described above can be made very light especially if suitable materials are used. Polyethylene has been used successfully.

In an operator's headset of this type the amplitude/frequency distortion due to the duct may be damped as mentioned above by the introduction of wadding, gauze or the like into the duct, if it is of ordinary flexible tubing, but if a segmented duct of the types described, is used adequate damping is provided by the presence of the tensioning spring. For some requirements additional damping may be necessary and it could be introduced into the air passages of the microphone with which the duct communicates. A roll of fine wire gauze answers this purpose well

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though there are many alternatives. The microphone of the headset shown in Fig. 1 has a cylindrical passage running diametrically across and over the diaphragm. The bore of this passage intersects the flat face of the cover which encloses the space over the diaphragm so as to leave a slit across the width of the diaphragm through which this space communicates with the cylindrical passage. Extra damping in the form of a roll of gauze has been introduced into this cylindrical passage with success.

In the application illustrated in Fig. 4, using a segmented duct of the type described the following dimensions for the duct are recommended as giving a suitable combination of lightness, mechanical strength and transmission characteristics:—

	inches
Over-all diameter of segments	.437
Diameter of bore of segments at the narrowest point -	.187
Over-all diameter of tensioning spring - - - -	.144
Spring wire diameter - -	.031
Radius of curvature of nesting faces of segment - -	.218
Overall length of segment	
Fig. 1 type - -	.45 inches
Fig. 2 type - -	.3 inches
Fig. 3 type - -	.25 inches

The Fig. 1 type segments, being fewer per unit length of duct make for a cheaper article and are suitable when the bends required are not sharp.

The shorter segments of Figs. 2 and 3 give greater flexibility and better retention of shape as there is less tendency to subject the spring to sharp localised bends than with the Figure 1 type. The increased number of segments per unit length of duct will raise the cost however.

It is desirable to use a material with a high coefficient of friction, where absolute retention of adjustment is required and this property is improved by increasing the tension of the spring.

A stiff spring is to be preferred where maximum damping is required as a spring requiring considerable extension to give adequate tension has more open convolutions and presents less wire surface for the air stream to pass over.

What we claim is:—

1. An acoustic device comprising a flexible acoustic duct incorporating a plurality of identical unitary hollow nesting segments, contiguous surface of which are shaped so as to maintain continuous annular contact between adjacent segments over a predetermined range of relative movement of adjacent segments with means passing through the duct for maintaining the segments in axial compression one against another.

2. A device as claimed in claim 1 in which the said compression maintaining means comprise an extensible member over which the segments are threaded, the member being anchored in longitudinal tension at both ends of the duct.

3. A device as claimed in claim 2 in which the extensible member is a helical spring.

4. A device as claimed in any one of the preceding claims in which one of two adjacent segments of the duct has an end of convex part-spherical form and the other of the two adjacent segments has an end of concave part-spherical form the convex end of the one segment engaging the concave end of the other segment.

5. A device as claimed in any one of the preceding claims in which at least one of each pair of adjacent segments of the duct is made of a material having a high coefficient of friction whereby the duct tends to retain the shape to which it is bent.

H. JOHN PRIOR,
Chartered Patent Agent,
For the Applicants.

PROVISIONAL SPECIFICATION

Acoustic Duct for Electro-Acoustic Transducer

We, STANDARD TELEPHONES AND CABLES LIMITED, a British Company, of Connaught House, 63 Aldwych, London, W.C.2, England, do hereby declare this invention to be described in the following statement:—

This invention relates to acoustic ducts for electro-acoustic transducers, and to telephone operators' headsets. One aspect of the invention is to mount the microphone of a telephone operator's headset on the head band and to provide an adjustable acoustic duct terminated by a small mouthpiece sound transfer from the mouth to the microphone.

For this and for other purposes it is frequently required to operate an electro-acoustic transducer at some little distance from the origin of the sounds or the place where the sound is to be delivered according to whether the transducer is of the microphone or the receiver type, and it is proposed to use a flexible duct for the purpose.

Flexible metallic tubing of the ordinary type may be used, but is inclined to be heavy, especially when it is of the "stay put" type which will retain the form into which it is bent.

It has been found that a tube made up

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of separate nesting segments, held together by the endwise tension of a spring or the like has many advantages as an acoustic duct.

The invention will be described in relation to certain embodiments illustrated in the accompanying drawings in which:—

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It is now proposed to fix the microphone to the head harness and extend the sound inlet by means of a flexible duct terminating in a flare opposite the mouth. Fig. 4 shows this arrangement with a segmented duct.

The duct must be flexible so that it can be adjusted to suit the individual operator and it must be of the "stay-put" type so that it will retain its adjustment. Unless the duct is made of light weight materials, it is liable to lose its adjustment in the same way as the boom-mounted microphone, when the head is moved. Most commercial flexible metallic tubing of the stay-put type is apt to be objectionable on this score and a special lightweight tubing should be used. On the other hand a segmented duct made in the manner described above can be made very light especially if suitable materials are used. Polyethylene has been used successfully.

In an operator's headset of this type the amplitude/frequency distortion due to the duct may be damped as mentioned above by the introduction of wadding, gauze or the like into the duct, if it is of ordinary flexible tubing, but if a segmented duct of the types described, is used, adequate damping is provided by the presence of the tensioning spring. For some requirements additional damping may be necessary and it could be introduced into the air passages of the microphone with which the duct communicates. A roll of fine wire gauze answers this purpose well though there are many alternatives. The microphone of the headset shown in Fig. 4 has a cylindrical passage running diametrically across and over the diaphragm. The bore of this passage intersects the flat face of the cover which encloses the space over the diaphragm so as to leave a slit across the width of the diaphragm through which this space communicates with the cylindrical passage. Extra damping in the form of a roll of gauze has been introduced into this cylindrical passage with success.

In the application illustrated in Fig. 4, using a segmented duct of the type described the following dimensions for the duct are recommended as giving a suitable combination of lightness, mechanical strength and transmission characteristics:—

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Spring wire diameter - -	.031
Radius of curvature of nesting faces of segment - -	.218

Overall length of segment

Fig. 1 type - -	.45 inches
Fig. 2 type - -	.3 inches
Fig. 3 type - -	.25 inches

The Fig. 1 type segments, being fewer per unit length of duct make for a cheaper article and are suitable when the bends required are not sharp.

The shorter segments of Figs. 2 and 3 give greater flexibility and better retention of shape as there is less tendency to subject the spring to sharp localised bends than with the Figure 1 type. The increased number of segments per unit length of duct will raise the cost however.

It is desirable to use a material with a high coefficient of friction, where absolute retention of adjustment is required and this property is improved by increasing the tension of the spring.

A stiff spring is to be preferred where maximum damping is required as a spring requiring considerable extension to give adequate tension has more open convolutions and presents less wire surface for the air stream to pass over.

With ducts of normal stay-put flexible tubing the size is not critical acoustically and ease of manufacture and the need for lightness will be the governing considerations. For instance, a bore of about $\frac{1}{8}$th of an inch would be adequate acoustically but it would be difficult to manufacture a flexible tube of the size which had adequate stay-put characteristics. There might also be difficulty in introducing gauze or the like into a tube as small as this but damping could be furnished by inserting a spring slightly opened but not under tension to provide resistance in the same way as in the case of segmented ducts. An overall diameter of about half an inch would be desirable for ease of manufacture but would probably be too heavy.

C. JOHN PRIOR,
Chartered Patent Agent,
For the Applicants.

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Sept. 15, 1959 J. J. DREHER ET AL 2,904,640

COMBINATION EAR-MOUNTED MICROPHONE AND RECEIVER INSTRUMENT

Filed July 30, 1957

4.

FIG. 3

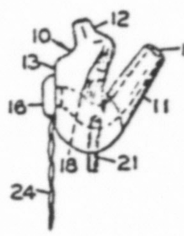


FIG. 2

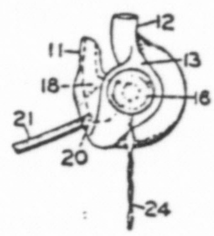
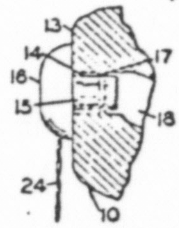


FIG. 4



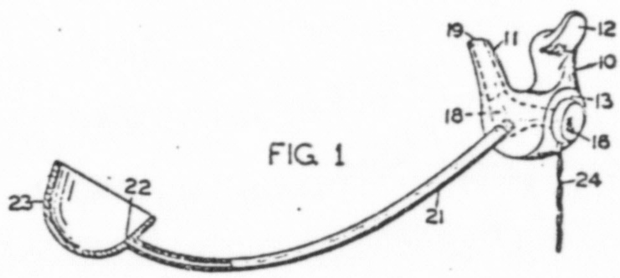


FIG. 1

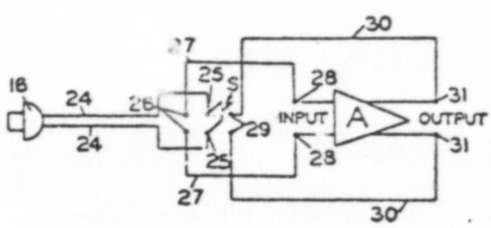


FIG. 6

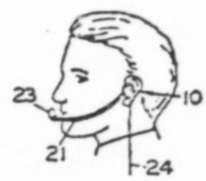


FIG. 5

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United States Patent Office

2,904,640

Patented Sept. 15, 1959

2,904,640

COMBINATION EAR-MOUNTED MICROPHONE AND RECEIVER INSTRUMENT

John J. Dreher, Worthington, and Lewis J. Schwartzkopf, Columbus, Ohio, assignors to The Ohio State University Research Foundation, Columbus, Ohio, a corporation of Ohio

Application July 30, 1957, Serial No. 675,078

4 Claims. (Cl. 179—156)

The present invention relates to audible signal transmitting and receiving apparatus and more particularly to a combined microphone and speaker device for use by aircraft personnel, radio operators, telephone operators or other persons using communication systems.

In the past, pilots, radio operators and other aircraft and ground personnel, have commonly used separate earphone-type receiver or speaker devices and lip, throat, or hand-held microphones to respectively receive and transmit voice signals. In some instances, the earphones and microphone are built into, or mounted in aviators' helmets or oxygen masks, or may be simply worn over the head and held in the hand where desirable. With the advent of high altitude flight, the hand-held microphone has been substantially replaced by the throat-type microphone or by a lip-type microphone built into the usual oxygen mask. However, considerable difficulty is still encountered with the so-called built-in types of earphones and microphones and the same are relatively costly and in some cases uncomfortable and unsanitary from the standpoint of the wearer.

Also, it has heretofore been proposed to employ the usual type of electromagnetic-vibrating diaphragm-type of earphone or receiver device as both a receiver and a microphone, but due to the relatively high noise level encountered in aircraft operation, previous attempts along this line have proved unsuccessful in attaining a desired signal-to-noise ratio necessary to transmit a clear, ungarbled and intelligible signal.

Accordingly, the primary object of the present invention is to provide a structurally simple lightweight combination microphone and speaker device adapted to be mounted in and upon the human ear and operable selectively either as a microphone or speaker in transmitting voice signals to and from the ear of a wearer.

Another object of this invention is to provide a combined ear-mounted microphone-speaker which is characterized by its ability to transmit comparatively clear, ungarbled and intelligible voice signals and which attains, when operating as a microphone, a desirably high signal-to-noise ratio without resort to the use of cumbersome and uncomfortable ear pads or other noise-shielding equipment.

It is a further object of the present invention to provide a device of this character which may be constructed from comparatively inexpensive, lightweight and readily available component parts, and one which may be easily fitted to and supported by the human ear and worn and operated in greater comfort than has heretofore been possible with the use of conventional types of earphones, headsets and microphones.

For a further and more complete understanding of the present invention and the various additional objects and advantages thereof, reference is made to the following description and the accompanying drawing, wherein:

Fig. 1 is a perspective view, partially in vertical section, of a preferred form of microphone-speaker device formed in accordance with the present invention;

Fig. 2 is a side elevational view of the ear plug or body portion of the present microphone-speaker device looking toward the outer side thereof;

Fig. 3 is an end elevational view of the ear plug body;

Fig. 4 is an enlarged fragmentary vertical sectional view taken through the ear plug body and illustrating the relative location of the sound-to-electrical impulse transducer;

Fig. 5 is a small scale perspective view illustrating the present microphone-speaker device as worn in the human ear;

Fig. 6 is a diagram of the electrical circuit of the sound-to-electrical impulse transducer and associated amplifier and switching mechanism.

The present invention proceeds on the principle of using a single, standard type of sound-to-electrical impulse transducer, both in the capacity of a microphone and as a receiver or speaker device. Furthermore, the present invention contemplates the use of such a transducer in combination with a molded plug-like body adapted to be snugly fitted directly to the outer regions of the human ear and formed so as to transmit audible signals both to and from the ear canal. Recent experiments have shown that voice signals may be transmitted with efficiency through the human ear canal and/or through the bone or tissue structure of the skull and ear. However, in surroundings of relatively high ambient noise and/or vibrations, such as in aircraft operation, it has been found that ambient noises and vibrations may also be transmitted through the skull and ear, thus making it difficult to attain a desired high signal-to-noise ratio which is necessary to transmit a clear and intelligible voice signal.

We have found that it is possible to obtain a desired signal-to-noise ratio in aircraft operations by utilizing an acoustic coupling of mouth and ear-emitted signals, such combined signals being conducted to the sound-to-electrical impulse transducer through suitable merging passages where such combined signals are translated into electrical impulses, amplified, and broadcast through conventional radio apparatus.

Referring now more particularly to the drawing, wherein is illustrated a single preferred form of the present invention, the numeral 10 designates generally a plug-like body which is preferably molded or otherwise formed from a suitable synthetic resin, and shaped to snugly and directly fit into the exterior regions of the human ear. The ear plug body 10 may, if desired, be custom molded to fit the ear of the individual wearer, or may, where desirable, be formed in generally standardized sizes and shapes after the manner of the usual ear plug or mold employed in connection with the ordinary hearing aid device. In the usual manner, the ear plug body includes a laterally projecting pipe-like extension 11 adapted to extend a distance within the ear canal, and a convoluted upper and forward retaining finger 12 which is adapted to fit beneath the outer tissue flap of the human ear to hold the plug or mold body 10 in substantially snug, flush-fitting relation to the exterior portions of the ear. The body 10 further includes a flat outer side portion 13 which is formed with a cylindrical socket 14 to frictionally and removably receive the tubular stem portion 15 of the usual button-like hearing aid transducer 16. In order to frictionally retain the transducer 16 within the socket 14 of the ear plug body 10, the latter is formed with an annular radially inwardly extending rib 17 which resiliently and frictionally engages the tubular stem portion 15 of the transducer 16 to hold the latter within the socket 14 against accidental withdrawal.

Communicating with the transducer-receiving socket 14 is an internal passage 18 which extends transversely through the body 10 and terminates in an opening 19 at

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the end of the canal extension 11 of the body. The body 10 is also formed at its forward end with a relatively small diametered socket 20 communicating with the passage 18, and in which is press-fitted the inner end of a relatively small diametered hollow tube 21. The tube 21, as shown in Fig. 5, is arranged to extend forwardly and laterally inwardly of the plug body 10 so as to partially encircle one side of the face of the wearer, and terminates substantially closely adjacent the lips of the wearer in an opening 22. Advantageously, the outer open end 22 of the tube 21 may be provided with a relatively small hemispherical cup-like body 23 which opens toward the mouth of the wearer so as to effectively focus voice signals emitted from the mouth and channel the same backwardly through the tube 21. If desired, particularly when the present device is used in aircraft operations, the open end of the cup-like body 23 may be closed by a protective film of polyethylene resin or the like so as to minimize undesired wind or other ambient noises.

Thus, it will be seen that when the present microphone-speaker device is used in the capacity of a microphone, voice signals, or sounds are conducted both through the tube 21 from the lips of the wearer and also through the ear canal to the internal passage 18 of the plug-like body 10 where the ear and mouth transmitted signals or sounds are combined and impressed upon the sound-sensitive element of the transducer 16. It is also thought that at least a part of the voice signals emitted by the wearer may be conducted through the bone structure of the skull and thence possibly through the tissue of the ear to the plug-like body 10, and thence to the sound-responsive element of the transducer. It has been found through experimentation that the signal-to-noise ratio encountered in ordinary aircraft operations is such that ear-transmitted signals alone, without a coupled mouth-transmitted signal results, in some cases, in a garbled unintelligible transmission. This is believed due to the transmission of external noises and vibrations through the body of the wearer and to the plug-like body 10 and thence to the transducer. However, by combining both mouth and ear transmitted signals, the signal-to-noise ratio is increased to a degree where the resultant broadcast is entirely clear, ungarbled and intelligible.

Fig. 6 of the drawing illustrates diagrammatically the operating circuit for the present combination microphone-speaker device. The sound-to-electrical impulse transducer 16 is provided in the usual manner with a pair of lead wires 24 which extend remotely from the button-like transducer and which are electrically connected respectively with the center poles or terminals 25 of a double pole, double throw switch S. It will be understood that the switch S may take any suitable standard form and may be located in a convenient, readily accessible position to be operated by the hand, or foot. The switch may, if desired, be spring pressed to a position to electrically connect the transducer 16 to the output side of the associated amplifier A, in order that the wearer may normally listen to or receive incoming signals, and may be manually switched to an opposite position connecting the transducer 16 to the input side of the associated amplifier A, in order that signals may be broadcast or transmitted by the wearer. Toward this end, the switch S includes a first set of secondary terminals 26 which are connected by the leads 27 to the input terminals 28 of the amplifier A. The switch S further includes a second set of terminals 29 which are electrically connected by the leads 30 to the output terminals 31 of the amplifier A. It will here be understood that the circuit diagram of Fig. 6 does not include in its showing the usual radio receiver and transmitter components, other than the common amplifier A which may be selectively connected either to an associated receiver or transmitter circuit in a manner well known in the art.

Thus, in the operation of the present microphone-speaker device, the switch S may be moved selectively to a position connecting the transducer 16 with the output of the amplifier A by way of the switch terminals 29 and leads 30 in order that the wearer may listen to incoming radio signals or broadcasts. Merely by manipulating the switch S to connect the transducer 16 to the switch terminals 26, the transducer is connected to the input side of the amplifier A in order that voice signals may be broadcast through the device.

In view of the foregoing, it will be seen that the present ear-mounted combination microphone-speaker or earphone device may be constructed of more or less standard, readily available and lightweight component parts, and may be connected through the use of a suitable double pole, double throw switch mechanism with the amplifier of a standard radio receiver-transmitter apparatus so as to function selectively both as an earphone receiver or speaker device and as a microphone.

The present combined ear-mounted microphone-speaker is characterized by its economy of manufacture, its comfort to the wearer and its operational efficiency and capability of attaining a sufficiently high signal-to-noise ratio, when operated as a microphone, to transmit clear ungarbled and intelligible signals even in surroundings of relatively high ambient noise. Further, due to the relatively small size and compactness of the present microphone-speaker, the same may be used conveniently by aircraft personnel and worn within the usual aircraft crash helmets or the like without in any way interferring with or obstructing the wearer.

While we have disclosed what we look upon to be a presently preferred form and construction of our improved combination microphone-speaker, it will be understood that the same is susceptible to modification in regard to details of construction and design without departing from the spirit of the invention or the scope of the following claims.

We claim:

1. A combination ear-mounted microphone and receiver comprising an ear plug body arranged to directly and snugly fit within the outer portions of a human ear and formed with a relatively elongated extension arranged to extend within the ear canal and an internal passage extending through said extension and terminating in a socket adjacent an outer surface of said body; a sound-to-electrical impulse transducer carried in said socket and communicating with the internal passage thereof; and an elongated tubular member having one end connected with said body and communicating with the internal passage formed therein, said tubular member extending outwardly from said body and terminating in an open outer end portion disposed closely adjacent the lips of a person in whose ear said body is fitted, the passage of said body and said tube serving to conduct sound waves emitted both from the lips and ear of a wearer to said transducer.

2. A combination ear-mounted microphone and receiver as defined by claim 1, including a relatively enlarged cup-shaped device carried on the open outer end of said tubular member.

3. A combined microphone and speaker device comprising an ear plug-type body formed with an open-ended passage extending therethrough and arranged to snugly fit within and be supported by the exterior regions of the human ear; a single sound-to-electrical impulse transducer carried in said body in communication with one end of said passage; and a relatively small diametered, open-ended, hollow tube carried at one end thereof by said body and communicating with the passage of said body intermediate the ends of said passage and having an opposite end portion extending remotely outwardly from said body and arranged to terminate adjacent the lips of a person in whose ear said body is positioned, said tube serving to conduct mouth-emitted sounds from the lips of a person wearing said device to the passage of said body and thence to said transducer.

4. A combined microphone and speaker device comprising a body of a shape and size to at least partially and

snugly fit into a human ear and having a passage therein arranged to communicate directly at one end thereof with the canal of an ear into which said body is fitted; a single sound-to-electrical impulse transducer carried by said body and communicating with the opposite end of said passage; and a relatively small diametered, hollow tube carried at one end by said body and arranged to extend outwardly from said body to a position closely adjacent the lips of a person in whose ear said body is positioned, said tube being open at both ends thereof and having one end communicating with the passage of said body intermediate the ends thereof, whereby sounds emitted from the lips of such person may be conducted through said tube to the passage of said body and thence to said transducer.

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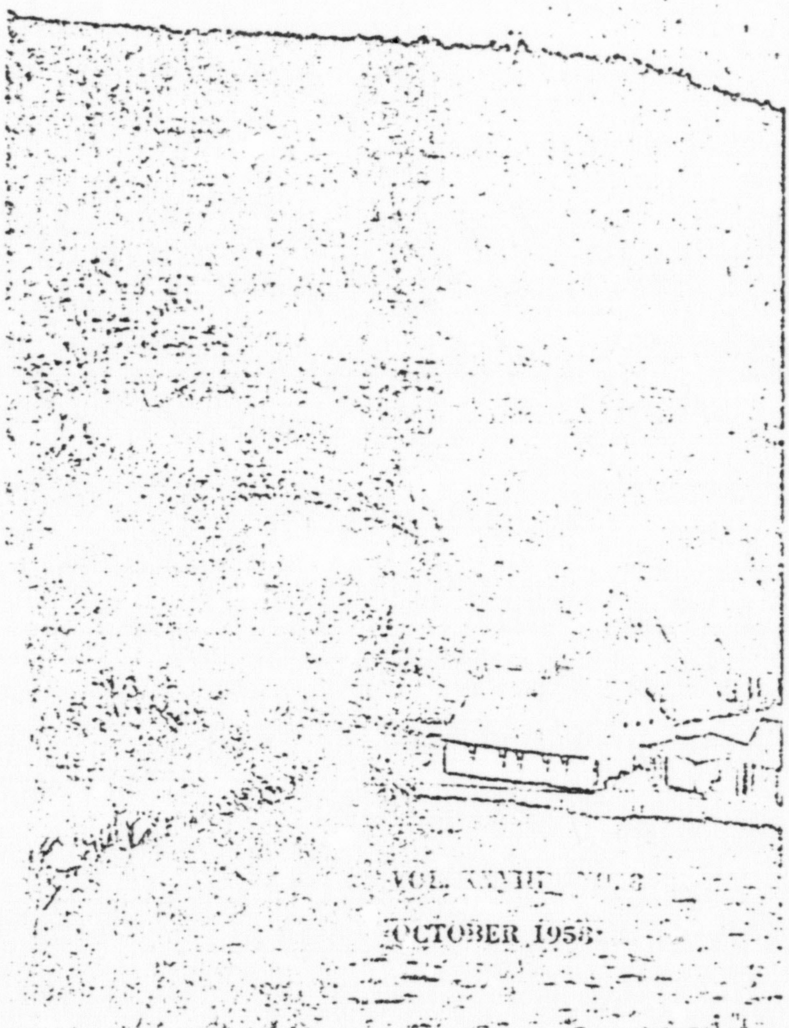
THE RADIOEAR

VOICE



VOL. XXVIII, NO. 3

OCTOBER 1958

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THE EARMOLD AS A PART OF THE RECEIVER ACOUSTIC SYSTEM

By S. F. LYBARGER

(An address delivered by the author to the Society of Hearing Aid Audiologists on October 10, 1958 in Chicago, Illinois.)

Every hearing-aid receiver is usually designed with the assumption that it will be used with an earmold having definite acoustic properties, at least within reasonable limits. When the earmold does have these properties, the published response curves for a hearing aid will have real significance, essentially to the degree that the "artificial ear" used in making hearing-aid response curves represents actual typical ears, and, of course, to the degree that the hearing aid manufacturer maintains his quality control. On the other hand, an earmold that deviates greatly from the receiver designer's planning can result in large departures from normal response characteristics in a hearing aid.

Intelligently used, earmold "deviations" may be beneficial; improperly used, they can produce some "weird" effects. Generally speaking, it is wise to provide the acoustic coupling planned by the receiver designer. It is the purpose of this discussion to try to look at the earmold as part of the receiver acoustic system and to see how such things as hole diameter, hole length, leakage, venting and other factors can affect hearing-aid response. Two types of receivers will be considered--the closely coupled miniature receiver using the conventional earmold and the small balanced-armature receiver with a relatively short length of tubing, such as is employed in most eyeglass hearing aids.

I. Conventional Receiver-Earmold System -

Let's consider the receiver-earmold system for the miniature receiver coupled to a standard snap-ring earmold. (Fig. 1)

Sound is generated in cavity V_1 when the alternating electrical energy from the hearing aid produces a vibratory force, through the action of the receiver mechanism, and causes the diaphragm to vibrate. Sound travels through the opening in the receiver nub, identified as tube M_1,

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R1, into the small cavity V2 usually present beyond the nub, into the longer tube M2, R2 and finally into the cavity V3 which is immediately in front of the eardrum. A leak, with which almost everyone in the hearing aid field is far too familiar, may transmit sound from cavity V3 to the outside air. Another leak may exist where the receiver nub engages the snap ring of the earmold, but this is one that can and should be eliminated.

The response curve of the total system frequently has characteristics similar to those indicated by solid curve of Fig. 1. Three basic frequency response regions are indicated. Let's assume that this is the receiver curve planned by the receiver designer. Generally speaking, if he used the American Standard 2 cc coupler for testing his receivers, he would expect cavity V2 to be negligibly small, tube M2, R2 to be .710" long and .120" in diameter, and cavity V3, when the "give" or compliance of the eardrum is taken into account, to be acoustically equivalent to an air volume of two cubic centimeters (or about 1/8 cubic inches). He also would have assumed very probably that leak M3, R3 and vent M4, R4 were negligible.

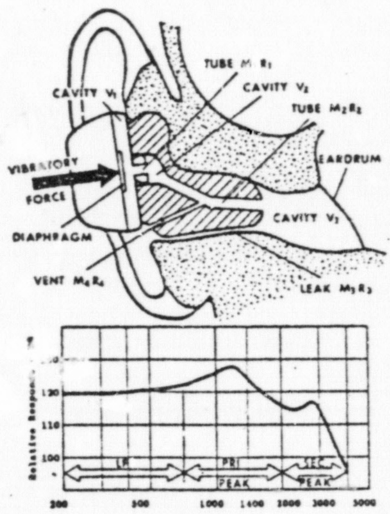

FIG. 1 - RECEIVER-EARMOLD ACOUSTIC SYSTEM AND TYPICAL RESPONSE

Now let's examine the effects, on the receiver response, of sizes of the earmold hole, etc., on the various frequency regions in the receiver response curve.

Low-Frequency Response

Consider first the low-frequency region. In Fig. 2, the elements that have the greatest effect on low-frequency response are checked. These are

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listed below in their approximate order of importance.

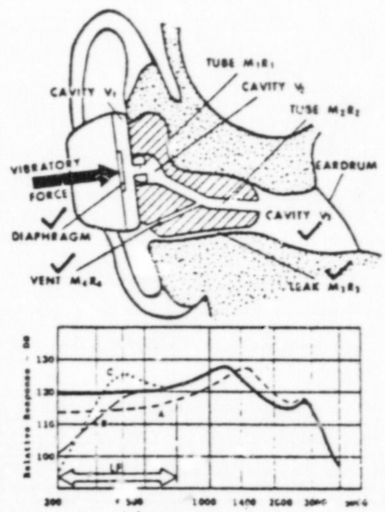

FIG 2 - ELEMENTS THAT AFFECT RESPONSE MOST IN LF REGION

1. Diaphragm Constants -

First and perhaps most important of these are the diaphragm constants--principally its stiffness--that are chosen by the designer. In speaking of the diaphragm constants we include also the effects of the driving system, which is magnetic in many receivers. Looking at Curve A of Fig. 2 we can see the general lowering of low-frequency response that might result from a stiffer diaphragm system. Note also that such a change raises the frequency of the primary peak in the adjacent frequency region.

Conversely, making the diaphragm more compliant (or less stiff) would make the opposite effect of raising the low-frequency output and the primary-peak frequency.

2. Leaks or Vents (M_3, R_3 or M_4, R_4) -

The reason we have designated the leak "M_3, R_3" is because, acoustically, it acts like a vibrating mass (M) (or weight) of air, plus an associated acoustic resistance (R) (or friction), that tends to reduce the amount of air movement that would otherwise occur.

Leaks that occur around an earmold, indicated by M_3, R_3 in Fig. 2, are usually "slit" leaks, having appreciable width and length but actually being quite small in thickness. Such a leak has a large component of resistance, or damping, and will affect low frequency response much as indicated by Curve B of Fig. 2.

A bad leak around the mold, or a rather large vent, such as M_4, R_4 in Fig. 2, may not have so much resistance and may act primarily as a fairly free vibrating "slug" or mass of air. Such a vent or leak can easily produce the effect indicated in Curve C of

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Fig. 2, where the extreme low frequencies are reduced but the more important lows are actually increased! It is suspected that many a mold vented to decrease low-frequency response has actually increased it. When a mold vent actually becomes large enough to produce a meaningful drop in medium low-frequency response, enough high-frequency sound usually escapes through the leak to produce a lusty feedback.

While very small vent holes are useful in speeding up barometric equalization for the eardrum, always question their effectiveness in reducing low-frequency response; they can often produce the opposite effect.

3. Size of Cavity V3

The amount of air volume between the end of the earmold and the eardrum can be controlled to some extent by the length of the earmold tip. The larger the cavity V3, the lower will be the sound pressure developed in it at low frequencies for a given movement of the receiver diaphragm. Conversely, a long tip, that effectively reduces the size of cavity V3, may produce a small improvement in low-frequency output, probably not exceeding 3 db unless the longer tip also reduces the effect of leakage.

Primary Peak Region

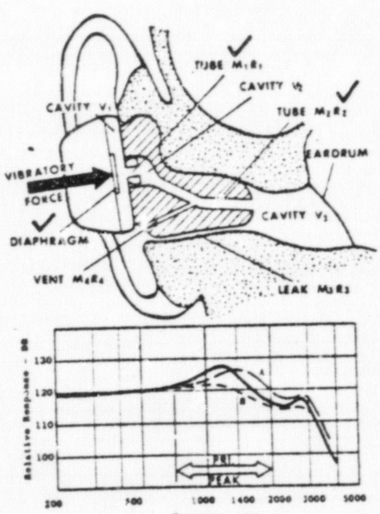

FIG. 3 - ELEMENTS THAT AFFECT RESPONSE MOST IN PRIMARY PEAK REGION

Now consider Fig. 3, with the items checked that have the greatest effect on what we have called the primary peak region. This is usually, but not always, the mid-frequency range from about 800 to 2000 cps.

Several things affect performance in this region:

1. The receiver diaphragm system constants, both stiffness and mass (or weight), have the greatest effect in determining the frequency of the primary peak. In combination with the mechanical or

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other damping (or resistance) of the diaphragm system, they also strongly influence the height of the primary peak. Curve A of Fig. 3 shows how the response curve might be affected by a reduction in the mass of the diaphragm system. Curve B shows how additional damping or resistance in the diaphragm system could lower the peak output.

2. Tube M2, R2, or more simply, the hole drilled in the earmold, plus the adjoining hole M1, R1, have a decided effect on the location and height of the primary response peak. If the earmold hole is the same diameter but longer than the one used in the standard 2 cc coupler, the primary peak will be lower in frequency; if shorter it will be higher in frequency. Similarly, if it is the same length but smaller in diameter the peak frequency will be reduced; if larger it will be increased.

Actually, the air in the earmold hole acts somewhat like a vibrating "slug" or acoustic mass that adds to the vibrating mass (or weight) of the diaphragm. In the typical general purpose receiver, the acoustic mass of the "slug" of air is perhaps only a fourth of the total that determines the primary peak, and therefore this peak is not critically sensitive to moderate departures in earmold hole size.

Because this slug of air vibrates back and forth rapidly at frequencies near the primary peak, anything placed in either tube M1, R1 or M2, R2 that causes acoustical friction or resistance, is very effective in flattening or damping the primary peak. For example, cotton or felt packed loosely in the earmold hole will produce the effect indicated by Curve B in Fig. 3. Plates or inserts with very tiny holes placed in the receiver nub hole are very effective in obtaining added acoustical resistance. Acoustical resistance at any location along the tube will be effective in reducing the height of the primary peak if this is desired. Frequently, of course, it is definitely undesirable.

From time to time the use of soft plastic in the earmold to "damp" out peaks is proposed. Another logical-sounding concept is that the roughness of the inside walls of the earmold hole can add appreciably to acoustic damping. Intriguing as both these ideas appear, measurements indicate that they have little foundation in fact. The solid curve of Fig. 4 was made using a very soft mold material with an earmold hole that was definitely rough inside.

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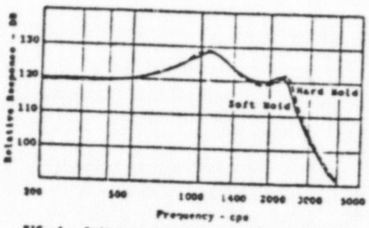

FIG. 4 - Soft Mold Material or Rough Hole Walls Have No Noticeable Effect

The hole in this mold was carefully measured in diameter and its length determined. Even the volume of the space in front of the receiver nub was carefully measured by determining the weight of mercury required to fill it. Then a duplicate "hole" was made by drilling a brass rod to the exact diameter and length required to match that in the soft mold. The hole was very smooth and, of course, rigid.

The dotted curve of Fig. 4 shows the response using the brass substitute. The difference in the curves is completely negligible. Rough walls and/or soft earmold material cannot be expected to produce peak damping.

Secondary-Peak Region

Now what about the upper end of the receiver's frequency range, which we have designated as the secondary-peak range? This is the frequency region that can be most strongly affected by the earmold. Three elements in our receiver-earmold system have large effects on the response in this region, as an examination of Fig. 5 will reveal:

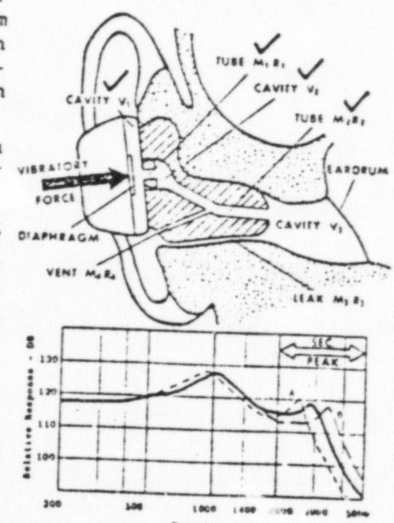

FIG 5 - ELEMENTS THAT AFFECT RESPONSE MOST IN SECONDARY PEAK REGION

1. Cavity V_1 in the receiver is highly important in determining the secondary peak frequency. The size of this cavity is usually chosen by the designer to give good output up to a suitable high-frequency "cut-off" point for the particular receiver design.

2. Tubes M_1, R_1 and M_2, R_2 (in combination) are critically important in determining what happens in the secondary peak region, as can be seen from Fig. 5. The solid curve is that

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obtained if the earmold hole were the length and diameter planned by the receiver designer. Dotted Curve A shows that for this receiver the reduction of the earmold hole diameter to .7 of its correct diameter lowers the high-frequency "cut-off" by some 500 cycles per second. (The hole length has been held constant.) Curve B shows that when the hole diameter is increased to 1.4 times its original diameter, the high-frequency "cut-off" is extended some 500 cps.

The same general effect is observed when the hole diameter remains constant and its length is changed. Curve A in Fig. 6 shows the effect of lengthening the hole; Curve B shows the effect of shortening the hole. Notice that the peak heights are much different than was the case when the diameter was varied. This is because the different damping due to the different hole diameters tends to equalize the peak heights in the curves of Fig. 5, but this compensation is not appreciable for the curves of Fig. 6, where the hole diameter remained constant. Smaller diameter holes have a larger acoustic damping effect.

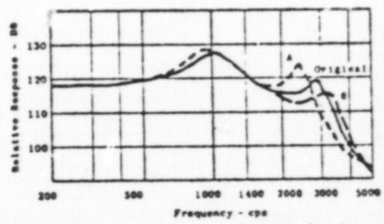

FIG. 6 - Effect of Hole Length on Secondary Peak Region

Figures 5 and 6 point up the approximate acoustic equality of a long hole of large diameter and a short hole of small diameter. Frequently this principle can be used effectively in earmold drilling.

The following table will be helpful in determining the diameter of an earmold hole to match the acoustic "mass" or "inertance" of the standard .710" long by .120" diameter tube size for which many hearing-aid receivers are designed:

Length of Hole	Diameter	Nearest Drill Size
.710"	.120"	#30 (Test Std.)
1/2"	.102"	#38
5/8"	.113"	#33
3/4"	.123"	#31
7/8"	.133"	#29

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3. <u>Cavity V_2</u> can affect the response significantly in the secondary peak region. This is the cavity just beyond the receiver nub as indicated in Fig. 5. The designer normally will assume that this cavity is negligibly small, so that the earmold maker should try to just clear the earmold nub with sufficient room to assure free sound flow from the receiver to the earmold hole.

Moderate increases in the size of cavity V_2 generally will reduce the high-frequency "cut-off" of the receiver somewhat. In one receiver tested (Fig. 7a) a change in cavity V_2 from a negligible size to .213" diameter and .103" long lowered the frequency of the secondary peak from 2850 cps to 2550 cps.

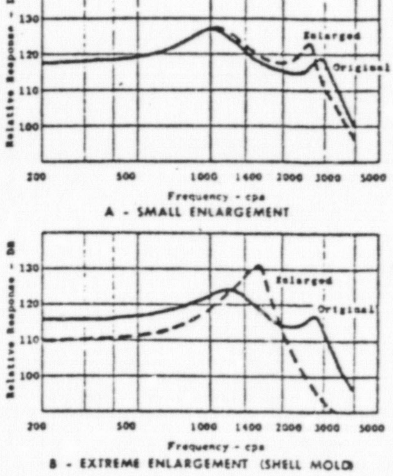

FIG. 7 - EFFECT OF ENLARGING CAVITY V_2

When <u>extreme</u> increases are made in cavity V2, unusual things happen. Fig. 7b shows what happened when the entire interior of an earmold was hollowed out, practically eliminating tube M_2, R_2 except for a short length at the tip. The secondary peak disappeared, along with much of the output above 2000 cps. Low frequency performance also suffered, as might be expected because of the greatly enlarged air volume into which the receiver was operating. The primary receiver peak increased markedly in frequency because the acoustic mass of the earmold hole disappeared, and it increased in height because the acoustic damping of the earmold hole was no longer present.

II. Balanced-Armature Receiver with Short Length of Tubing to Earmold-

Most eyeglass and many behind-the-ear hearing aids use a very small and efficient balanced-armature receiver that is usually designed to be coupled

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to the ear through a plastic tube, 2-1/4" long and .077" in diameter. Figure 8 illustrates such an acoustic system. Sound is generated in cavity V_1 when the diaphragm vibrates. This is transmitted directly into cavity V_3 through a tube M_2, R_2 whose diameter remains nearly constant from end to end. A constricting damping plug M_1, R_1 is often used to reduce peaks and is usually placed at the receiver end of the tubing. The cavity V_2, representing the space at the end of the conventional receiver nub (Fig. 1) is no longer present. We still have with us the leak M_3, R_3 and the possibility of a vent M_4, R_4. Sound is again delivered to the cavity in front of the eardrum V_3.

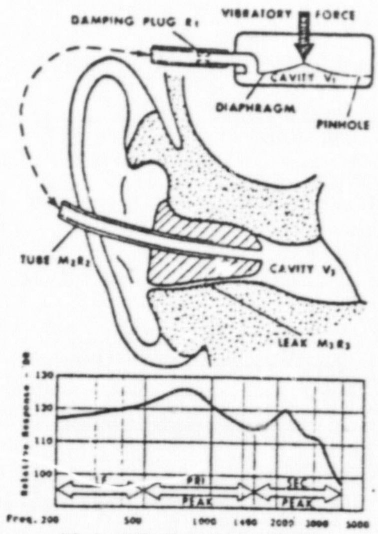

FIG. 8 - RECEIVER EARMOLD ACOUSTIC SYSTEM AND TYPICAL RESPONSE

The response curve of such a receiver-earmold system might be like that indicated at the bottom of Fig. 8. Again we can divide the response curve into three main frequency regions.

The factors that affect low-frequency response most are essentially the same as indicated for the conventional type receiver and are indicated in Fig. 9. They are the diaphragm constants, the leak M_3, R_3 or vent M_4, R_4 and the size of cavity V_3.

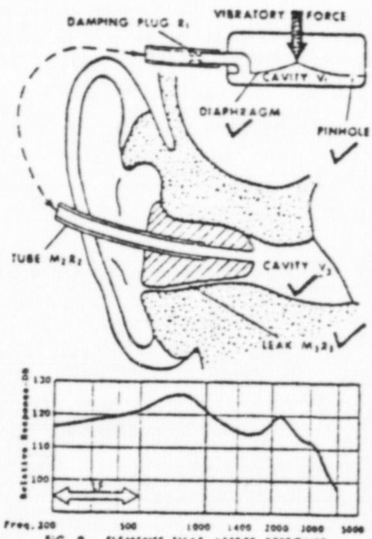

FIG. 9 - ELEMENTS THAT AFFECT RESPONSE MOST IN THE LF REGION

Two comments are in order here. First, existence of a leak M_3, R_3

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or vent M_4, R_4 will usually not be tolerable because of acoustic feedback, so loss (or enhancement) of low-frequency output because of them may not be so serious a problem. Second, because of the length of the tube employed, the primary peak region may extend into what we usually consider the low-frequency region (i.e. below about 800 cps).

When we consider the factors that influence the primary peak region most, as shown in Fig. 10, we find them to be the length and diameter of tube M_2, R_2, the diaphragm constants, and the damping plug R_1.

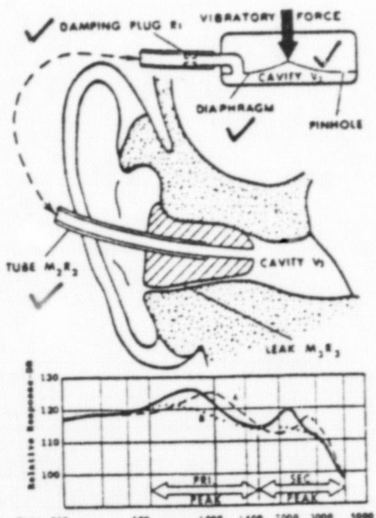

FIG. 10 - ELEMENTS THAT AFFECT RESPONSE MOST IN THE PEAK REGIONS

The longer length of tube M_2, R_2 becomes much more important in determining the frequency of the primary peak than was the case with the conventional type earmold. A much larger percentage of the total acoustic mass now lies in the "slug" of air in the tube. Curve A of Fig. 10 shows the effect of shortening tube M_2, R_2.

The stiffness and mass of the diaphragm continue to have an important influence on the primary peak but are, of course, fixed by the design.

The damping plug R_1, exerts a very strong controlling effect on the height of both the primary and secondary peaks, as is indicated in Curve B of Fig 10, in which additional acoustic resistance has been added. Graduated control of the peak height can be obtained by using a series of acoustic resistance values in the damping plug.

Damping plugs do not always produce the same response changes in a complete hearing aid as they do on receivers measured alone, particularly if considerable negative feedback is present over the last

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amplifier stage. Under some conditions, usual types of damping plugs may have little effect.

Increasing the diameter of the tube M_2, R_2, keeping its length constant, raises the frequency of the primary peak, and because of lower damping in the tube, usually increases the height of the primary and secondary peaks.

Except to provide a good fit with comfort, the actual earmold part of the receiver-earmold system used in an eyeglass type aid does not offer much possibility of acoustic control. The hole beyond the end of the tubing constitutes only a small part of the total length of tube M_2, R_2 and its diameter is therefore not critical as long as it is about the same as the I.D. of the plastic tube.

Changes in tube length can materially affect response but are difficult to make unless a device is invented to shift the ear around on the side of the head as needed.

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June 7, 1960 J. D. HENDERSON 2,939,923

HEARING AID PLASTIC EAR PIECES

Filed Aug. 3, 1955

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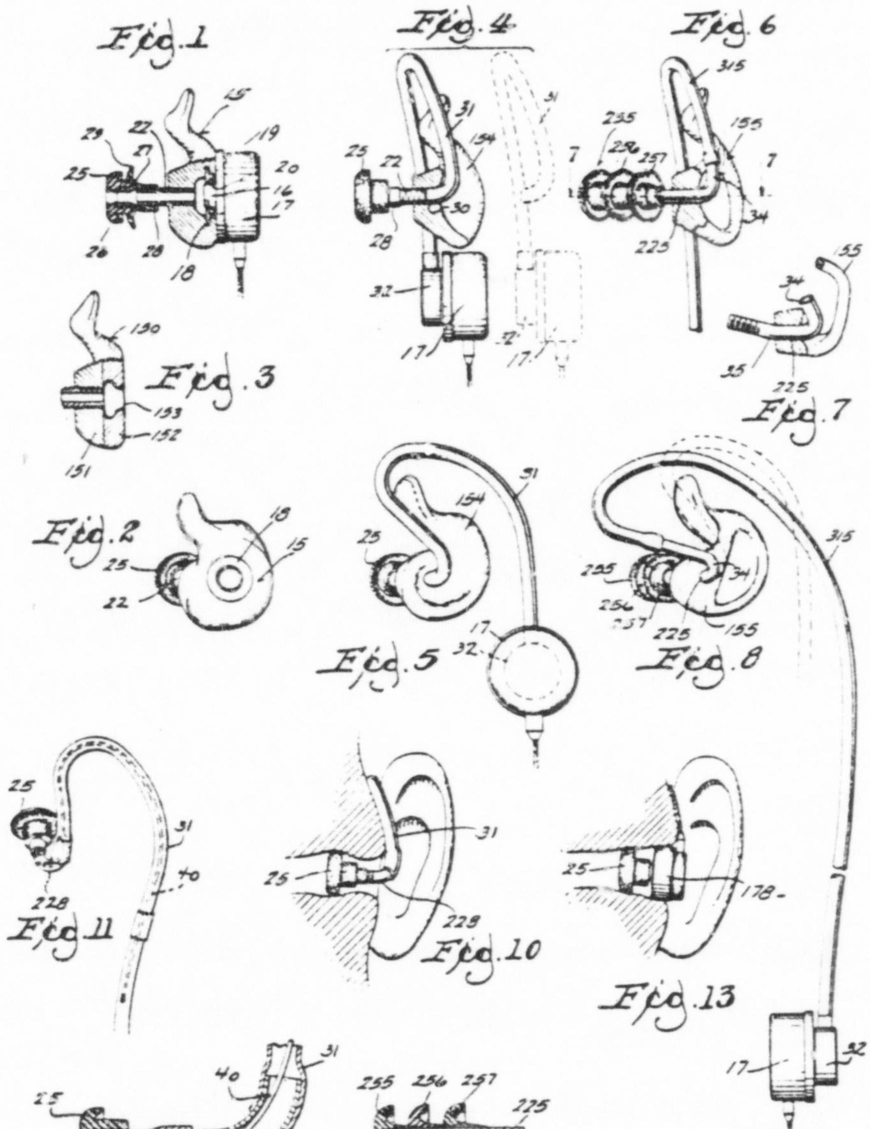

INVENTOR.

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BY

Wheeler, Wheeler & Wheeler

ATTORNEYS

125

United States Patent Office

2,939,923

Patented June 7, 1960

2,939,923

HEARING AID PLASTIC EAR PIECES

John [illegible]. Henderson, 4203 N. Morris Blvd., Milwaukee, Wis.

Filed Aug. 3, 1955, Ser. No. 526,126

5 Claims. (Cl. 179—182)

This invention relates to hearing aid plastic ear pieces.

The major feature of the invention consists in the provision of a very soft tip for insertion into the auditory canal. The tip is desirably mushroom shaped with a radially projecting flange or head and it desirably comprises synthetic sponge whereby it is not only exceptionally soft but is somewhat porous. Such a tip is not only much more comfortable than any heretofore known but it may be used coincidentally with medication because its porosity enables it to retain the medication while the hearing aid is being worn instead of excluding the medication from contact with the skin of the auditory canal.

The degree of softness of the tip is such tha[illegible] could not be introduced into the auditory canal w[illegible] it not supported upon an inner plastic tube desirab[illegible]canized to the tip and which, while, resiliently flexible, [illegible] yet sufficiently rigid to be used as a means of propelling the tip into position. I may also provide the shank of my improved synthetic sponge tip with a secondary head or heads which may be of increased diameter as compared with the first head, the first head serving to anchor the shank within the second head against accidental withdrawal.

Another feature of the invention consists in the manner in which the parts of the tip are connected to each other and to a molded insert which is desirably used as a means of anchoring it in the concha of the outer ear, the receiver being alternatively mounted directly on this insert or at the end of a tube leading to the insert and thence to the tip first described above. In certain cases I connect the receiver directly with the tip, the receiver in such cases being small enough to fit into the end or interior of the auditory canal.

Where the concha fitting is dispensed with, I may use another means of [illegible]noring the external tubing about the wearer's ear, including a piece of deformable spring wire shaped to fit over the ear and disposed within the sound tube.

In the drawings:

Fig. 1 is a view partially in side elevation and partially in section showing a hearing aid ear piece made in accordance with a preferred embodiment of this invention.

Fig. 2 is an end elevation of the device of Fig. 1 with the receiver omitted.

Fig. 3 is a view similar to Fig. 1 illustrating a modified embodiment of the concha insert.

Fig. 4 is a view partially in side elevation and partially in section showing a modification of the device of Fig. 1, the speaker being at the end of a sound tube encircling the wearer's ear.

Fig. 5 is a view in perspective of the device of Fig. 4.

Fig. 6 is a view partially in perspective and partially in section showing a further modification of the device of Fig. 4.

Fig. 7 is a fragmentary detail view taken in section on the line 7—7 of Fig. 6.

Fig. 8 is a view in perspective showing the device of Fig. 6.

Fig. 9 is an enlarged detail view in axial section of the auditory canal insert used in the device of Figs. 6 and 8.

Fig. 10 is a view partially in side elevation showing a further modified embodiment of the invention, portions of the auditory canal being shown in section.

Fig. 11 is a view in perspective of the device of Fig. 10.

Fig. 12 is an enlarged detail view in axial section of an end portion of the device shown in Figs. 10 and 11.

Fig. 13 is a detail view in side elevation of a further modified embodiment of the invention, portions of the auditory canal being illustrated in section.

It is conventional practice to provide numerous forms and sizes of the concha-insert generically designated herein by reference character 15. My insert 15 differs from conventional practice in that, in the first place, it is desirably made of reasonably flexible plastic. Instead of being hard, it is relatively easily deformable so that it readily adapts itself to the wearer's ear notwithstanding that the latter may deviate from the various standards which have been set up in the industry.

In the second place, my improved insert 15 is desirably made as shown in Figs. 1, 2 and 3 for the detachable reception and retention of the sound discharge sleeve 16 of the electrical speaker 17. In the construction shown in Fig. 1 and Fig. 2, a hard insert 18 flanged for permanent retention in the plastic mold 15 has been molded into the plastic. It has an undercut groove at 19 to receive a snap ring which releasably engages the shallow groove 20 in the sound discharge sleeve 16 of the speaker 17.

Instead of providing the plastic element [illegible]h a metal insert 18, I may make the element 15 of [illegible]pes of plastic fused together as shown in Fig. 3 at 150. The over-all shape remaining the same, there is a base component 151 having a high degree of resilient flexibility and a relatively much more rigid component 152 which, while retaining sufficient flexibility to receive the enlarged end of sleeve 16, still has rigidity enough to prevent the escape of such head from its constricted mouth at 153 through accident. The devices of Figs. 3 and 1 are both adapted to receive and detachably support the speaker unit 17 upon the concha element or retainer 15.

A short length of relatively rigid but somewhat flexible tubing 22 which is externally screw threaded is screwed or molded into the fitting 15 and projects therefrom in a direction to enter the auditory canal and to receive sound waves issuing from the output sleeve 16 of speaker 17. The tip generically designated by reference character 25 is molded of very soft synthetic sponge in the preferred embodiment of the invention, its head portion 26 being soft enough to adapt itself not only to a wide variation of diameters of auditory canals of different wearers but to conform to the various shapes which such canals may assume in cross section. The synthetic sponge may be rubber but is desirably a spongy plastic (synthetic resin).

The shank portion 27 of the tip 25 is joined by fusion or vulcanization or by adhesive integrally with a plastic tube 28, the outer end of which is forced over the screw threaded tube 22 and is threaded thereon to any desired extent of telescopic lap. The element not only provides a secure mounting of the tip on tube 22 but also permits a very substantial range of axial adjustment to adapt the device to the requirements of different wearers. The sleeve 28, like the tube 22, is relatively considerably stiffer than the synthetic sponge tip 25, since otherwise the

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tip could not be forced into place within the user's auditory canal.

Optionally I may provide an additional annular flange 29 seated on the tubular shank 27 of tip 25 and likewise made of very light soft synthetic sponge. The auxiliary flange or head 29 will usually be of increased diameter. It provides an easy and satisfactory way of adapting the tip to the auditory canal of a person whose canal is bigger than that for which the dimensions of tip 25 were designed. The head 26 of the tip 25 prevents relative displacement of tip 25 with respect to the auxiliary head 29 in the direction of withdrawal. It is thus impossible for the auxiliary head 29 to become lost within the auditory canal of the wearer, since withdrawal of the hearing aid will necessarily take the auxiliary head 29 with it.

As stated above, the fact that the head 25 and the auxiliary head 29 are made of soft porous spongy material not only makes the respective heads easily conformable to the patient's ear canal contours, but enables the tips to be used as applicators for the medicinal treatment of the skin surfaces of the canal. In the use of ordinary hearing aids, the surfaces engaged by the plug or insert are inaccessible to medicaments and can not be treated while the hearing aid is being worn.

In the device shown in Figs. 4 and 5, the plug or insert 25 may be identical with that shown in Fig. 1. The threaded tube 22 does not extend as far into the concha element 154, leaving a socket at 30 into which the end of flexible tube 31 is inserted to carry sound over the wearer's ear from the connector 32 of receiver 17. Since the receiver is remote from the concha fitting 154 the latter is shaped differently and has no means for receiver connection such as that shown in Figs. 1–3. As shown in dotted lines, it is readily possible to disconnect the speaker and the speaker tube 31 by withdrawing the end of the latter from the fitting 154.

Figs. 6–9 show a somewhat differently shaped concha fitting 155 and the tube 225, instead of stopping at the fitting as in Figs. 1 and 4, is carried through to the outside of the fitting and turned upwardly at 34 to receive a telescopic sleeved connection with the free end of the speaker tube 315. This tube, instead of being short, to position the speaker behind the ear, as in the device of Figs. 4 and 5, is long enough to locate the speaker within the wearer's shirt or elsewhere.

The tube 225 which projects into the auditory canal from the concha fitting 155 is also somewhat elongated and carries a multiple sponge material head. The outer head 255 corresponds closely to that shown in Figs. 1-5 but desirably has a tapered shank at 275 onto which the second head 256 is forced. This in turn has a tapered shank 276 onto which the third head 257 is forced. Any desired length of tube 225 may be used and any desired number of soft heads 255, 256 and 257 may be mounted thereon.

It will be observed that the device is adjustable to extend the tube 315 from the elbow 34 at any desired angle and to any desired length. Fig. 7 shows the elbow rotated to a different angle from that shown in Fig. 6 and it also shows the threaded inner end of tube 225 bent at 35. Larger or smaller ears are accommodated by simply adjusting the tube 315 over the wearer's ear and cutting off any surplus from its free end before the latter is sleeved over the elbow 34.

Figs. 10 to 13 show the concha fitting eliminated altogether. The synthetic sponge insert 25 shown in Figs.

10 and 13 is identical with that shown in Figs. 1-5. The flexible but less yieldable tube 228 has direct connection either with the sound tube 31 shown in Fig. 10 or with a small diametered speaker 178, fitting within the auditory canal as shown in Fig. 13.

Where the construction of Fig. 10 is used, it may optionally be desired to provide some means other than the concha insert to hold the equipment in place on the wearer's ear. For this purpose I may use within the sound tube 31 a piece of wire as indicated at 40. The wire is sufficiently flexible so that it can be manipulated to a desired form and it is sufficiently resilient to return to that form after any normal deformation involved in applying or removing the hearing aid. The internal wire will, therefore, hold the sound tube 31 in a position which will conform it closely to the contour of the wearer's ear at the junction of the ear to the head, thus serving as a means of holding the plug in its proper place in the auditory canal.

I claim:

1. A hearing air ear plug comprising a sponge tip mounted on a separately fabricated tube, the tip and tube being of different materials having different degrees of flexibility and unitarily connected, the tip being so soft and easily deformable that it cannot readily be inserted within the ear canal without support, the tube opening through the tip and being of a material sufficiently flexible to accommodate itself readily to changes in direction of the ear canal but sufficiently stiff to support, guide and propel the tip during insertion, and to maintain an opening through the tip when in use.

2. The device of claim 1 in which said tip is mushroom shaped, having a tubular shank portion sleeved on the tubular support, and at least one flaring peripheral flange.

3. The device of claim 1 in further combination with a sound tube communicating with the tube first mentioned and having a free internal longitudinally extending wire yieldably defining the direction of the sound tube.

4. The device of claim 1 in which the tip has a shank portion telescopically lapping the tube to an adjustably predeterminable extent, whereby to position the tip at a predetermined point in the ear canal, the tube having means for locating its position respecting the outer ear.

5. In a hearing aid the combination with a tubular support sufficiently flexible to accommodate itself to the external ear canal, of a first head integrally comprising a tubular shank portion and a peripheral flange of highly flexible soft sponge material, said tubular shank portion being telescopically positioned on said support, and a second head of flexible soft sponge material mounted on the support and integrally comprising a tubular shank portion and peripheral flange, the second head having its shank portion sleeved on the shank portion of the first head and encircling the support.

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Operational Tests of Miniature Microphones and Receivers

By
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Technical Report No. 36
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Operational Applications Laboratory
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Technical Report 36

TECHNICAL

R E P O R T

By

THE OHIO STATE UNIVERSITY
RESEARCH FOUNDATION

Columbus 10, Ohio

To:	AIR FORCE CAMBRIDGE RESEARCH CENTER OPERATIONAL APPLICATIONS LABORATORY BOLLING AIR FORCE BASE, WASHINGTON 25, D.C. Contract No. AF 19(604)-1577 Project No. 7681
On:	OPERATIONAL TESTS OF MINIATURE MICROPHONES AND RECEIVERS.
Submitted by:	Henry M. Moser and John J. Dreher Department of Speech
Date:	October, 1956

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Lt. Colonel Roland L. McRae	Director of Operations
Major Paul A. Fredericks, III	Deputy Director of Operations
Major John B. Horsfall	Wing Chief Pilot (Speaker A)
Major Clinton P. Hankins	Chief Pilot (Speaker B) 1742nd Air Transport Sqdn.
Captain Santiago Gonzales	Chief Pilot 1707th Flying Training Sqdn. (Amp)
Captain Muller L. Jones, Jr.	Chief Pilot (Speaker C) 1740th Air Transport Sqdn.
CWO Fred W. Carter	Air Electronics Superintendent

OPERATIONAL TEST OF MINIATURE MICROPHONES AND RECEIVERS

I. INTRODUCTION

While previous laboratory experimentation has shown promising performance with microphones located at positions other than the mouth,[1-4] no operational tests have hitherto been accomplished.

The present interphone system (AIC-10) used in most Air Force craft employs a first-order-differential noise cancelling microphone developed to generate a high quality signal in the ambient noise fields encountered operationally. A modification of this microphone, the M-33, is currently in use in the majority of aircraft flying at moderate altitudes at subsonic speeds. The A13A oxygen mask inserted counterpart, the M-32, in the AIC-10 system is essentially the same microphone but offers the advantage of a shield for the speech signal.

Both these microphones, although functioning satisfactorily in their primary purpose, have presented problems from a standpoint of maintenance. Moreover, the associated headset is considered extremely annoying by personnel on duty in hot, humid climates where long duty periods have resulted in much sweating into the ear cushions. Bases with training missions have been particularly affected by this latter circumstance, in some instances being severely hampered by the spread of ear fungi transmitted through common usage of headsets by students.[5]

The problem, then, from the operational point of view, is two-fold. Both the transmission and reception of signals would be improved by lightening the weight and simplifying radio equipment; hygiene and santitation would be improved by equipment cheap enough to allow personal ownership of components.

Concurrent with laboratory evaluations of ear, bone, and mouth transducer signals,[6] a staff study on an experimental version of a headset-microphone combination adapted to the needs of hot-weather flying was instituted at Palm Beach Air Force Base by Lt. Colonel Roland M. McRae, Director of Operations, 1707th Air Transport Wing, Heavy (Tng), and implemented by Major Paul A. Fredericks, III, Deputy Director of Operations. This study was initiated to attempt a solution to the sanitation and comfort problem discussed above.

The experimental model of this microphone-headset combination is described in a memorandum to Commander, 1707th Air Transport Wing, dated June, 1956. Briefly, this apparatus consisted of a Telex #3776 binaural headset for listening and a modified M-32 microphone. The latter, connected to about three feet of plastic tubing, is clipped to the operator's shirt front. The speech signal is picked up at the speaker's lips by a small plastic circular container of approximately 13 cc capacity attached to a curved 6" section of hollow aluminum tubing borne by the headset. Quite apart from the good quality signal delivered by this apparatus, it offered relief from the weight and discomfort

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involved in using the standard H78/AIC headset-microphone (wt. 1 1/3 lbs). Subjective evaluation by Wing personnel had already been favorable and the overall performance amounted, in their judgment, to an improvement over the standard equipment. It was in connection with this staff study that this laboratory was contacted for the purpose of conducting flight tests of some available miniaturized microphones.

Two types of transducers previously used in laboratory studies were considered for testing: a magnetic ear insert, weight 1/2 ounce, a bone oscillator, weight 3/4 ounce. Each could be used for both transmitting and receiving.

Authorization was given for such tests to be made at the 1707th Air Transport Wing, Heavy (Trg.), Continental Division, MATS at Palm Beach Air Force Base, in routine training flights.

II. EXPERIMENTAL DETAILS

A. Aims

The primary aim of the operational test was to compare the efficiencies of the currently used M-33 microphone with selected ear insert and bone transducer as used in conjunction with the AIC-10 communication system. Because of the problems of experimental design posed by an operational test, the second task of comparing receivers could not be rigorously structured. The latter task, however, hardly needed any rigid experimental structure, in view of the attitude of flight personnel to the effect that any relief from the weight, discomfort, and sanitation problems of the standard headset would be a welcom improvement. The results of receiver comparisons will be treated at greater length below.

B. Transmission Tests

1. Stimulus Materials

Stimuli for transmission tests were randomized lists of 200 Harvard PB words. These words, read in trios with time for written responses interspersed, were arranged in lists of 50 words each.

2. Aircraft Selected

Two models of transport aircraft were used in the testing, the KC-97 and the C-124, on the assumption that results achieved with these could be generally applied to all other types of heavy motor craft now in general use. Both airplanes, although not excessively noisy according to present day standards, make some degree of noise exclusion mandatory for satisfactory transmission. Noise levels in the C-124 are somewhat higher than those encountered in the KC-97 (97 db in level flight).

3. Speakers

Comparison readings for the M-33, ear and bone microphones were made by three chief pilots in both the KC-97 and C-124 airplanes. Prior

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to reading their test lists all speakers identified themselves and transmitted a standard sample of continuous speech using each type of microphone. This served to prepare the speakers for test list transmissions and for microphone identification. Both pilots who read test material from each aircraft broadcast first with the M-33 microphone, following with ear and bone transducers. In each case the ear microphone was coupled to a custom-fitted ear mold and covered with a David Clark, model 372-8 ear muff. The bone microphone was positioned in the center of the speaker's forehead and held in place by the pressure exerted by the head band, designed for the unit, spanning the head longitudinally. It is to be pointed out that no attempts were made to modify this pressure to obtain optimum performance in view of the limited time available for flight operations. This transducer was not shielded from the ambient noise.

All transmissions were recorded on the ground from the UHF channel assigned, 349.4 megacycles.

4. Equipment

Standard, commercially available equipment was used in all phases of testing. Dyna-Empire magnetic insert earphone model D 314 and Dyna-Empire bone conductor model B 36 were used to transmit signals from the ear and the skull respectively. Preliminary comparison of the output levels of the M-33 microphone and the Dyna-Empire units indicated a level of approximately 20 db less for the latter. Consequently, a transistor preamplifier,[6] was used to increase the signals from the ear and bone transducers. Standard cords were fitted with appropriate connectors for coupling to the AIC-10 transmission system. A model 600 Ampex tape recorder was coupled electrically to the receiver at the ground station by means of a repeat coil to record the test messages.

5. Broadcast Evaluations

a. Listeners

A panel of 10 listeners, trained for a period of 30 hours on the test words, and currently engaged in evaluation of several other experimental microphones, listened to the test lists as read by the participating pilots. Write-down responses were used.

b. Playback of Lists

Two conditions of playback were used, one using only the output of the tape as recorded over the transmission link at the ground station, the other introducing additional noise into the listening circuit. Since the former condition effectively reproduced the listening conditions at the tower station, only these results will be commented on below.

The listeners used PDR-8 headsets fed by the Ampex 600 recorder. Listening was done in quiet. The signal, plus whatever noise was picked up during the recording in the aircraft, was played back through the headsets at a level of 77 db, C scale, on the H.H. Scott 410-B sound level meter. This amount was an average reading taken from three of the earphones

in the listening circuit. In each instance the reading was made by coupling the earphone to the meter by a rubber coupler.

c. Results and Discussion

Two types of materials were transmitted with all three microphones. To identify the microphone, speaker, and test lists subsequently read, the pilots first transmitted a standard passage:

"This is __________, broadcasting with the __________ microphone. Our altitude is 9500 feet. 1,2,3,4,5,6,7,8,9,10. JOE TOOK FATHER'S SHOE BENCH OUT. This is the end of the __________ microphone reading."

In addition to this connected speech sample the pilot also gave several brief operational messages (i.e. request for instructions, for quality of signal, etc.) before commencing the second type of material, the PB word lists. During the transmissions and later in playback, communications and operational personnel gave their subjective reactions to the transmissions. The consensus was that all microphones were quite satisfactory (or, as they expressed it, "5 by 5"), a result that requires some comment.

In the first place, any existing differences in the three microphones would tend to be obscured due to the fact that a standa passage was employed and that listeners had knowledge of the context. The operational phrases, however, offered a somewhat more reliable measure, since their content was not exactly foreknown. What may be of much greater importance is the observation that the scale of judgment for connected speech is almost certainly measuring something quite different from that employed in the evaluation of the transmission of the test words. Communications personnel employ, in theory at least, a 5-point yardstic. of "readability" and "strength" to evaluate each other's transmissions. An optimum transmission might be labelled "R-5, S-5" ("5 by 5", or "5 square") to denote excellent readibility and strength. Any lower readings given stand for the receiver's judgment of how far the signal departs from optimum reception. In practice, the two 5-point scales are often combined, with no differentiation made between the two categories. "Reading you two," for instance, would thereby indicate poor reception. In view of the fact that operations personnel are generally not interested in the quality of the signal itself but whether or not it can be read, the judgment tends to become even more gross, with a sufficiently strong, readable signal considered "acceptable," and only those circumstances which actually make communication extremely difficult or impossible resulting in a judgment of "unacceptable."

Essentially, then, the signal is labelled either satisfactory or unsatisfactory in operational use, the normal redundance of connected speech tending to iron out differences which might well appear among microphones in the transmission of isolated words. During the recording of the test lists, for instance, experienced operations personnel listening to the transmissions unhesitatingly evaluated samples of connected speech from all three types of microphones as "five by five," a circumstance which seems to indicate that the gradations of difference as established by laboratory tests on trained listening panels may not be significant from an operational point of view. Certainly when such aspects as comfort, ease of handling, and durability of

equipment enter the picture it may become unrealistic to base any performance evaluation solely on the results of articulation scores. They do serve, however to point out the direction for engineering improvement, inasmuch as the transducers compared with the currently used microphone were selected from commercially available sources wit no choice of the specific response characteristics necessary for this speaking situation.

An interesting observation may be made regarding the operation of the bone microphone as used in the KC-97 test when the speakers recorded their lists, one wearing ear muffs, one without. At the time of transmission, a noticeable betterment in voice quality was remarked upon by auditors at the ground station when the speaker was wearing muffs, and subsequent listener effort proved that this condition resulted in superior articulation scores. This improvement cannot be attributed to speaker variability since on no other condition was any statistical speaker difference noticed. It is to be supposed that the pressure exerted by the muffs in some way reacted with skull vibration to achieve this more distinguishable signal.

Another point that may be worthy of mention was the expressed opinion of several operational listeners that breath blast from the M-33 microphone makes connected speech "annoying to listen to." Actually, the subjective reactions of most of the operational personnel placed the bone microphone transmissions "better than the present (M-33) mike," an observation running counter to laboratory findings on the comparative readability of the microphones, and one that obviously was based upon additional (and perhaps valuable) criteria not revealed by an articulation test. The extent to which such annoying features of a microphone affect its operational use are largely unassessed, although it is entirely possible thay they loom larger in importance to the everyday user than they would to laboratory personnel trained in evaluation of equipment under widely varying conditions of reception.

The statistical evaluation of the tests is presented below. It will be noted from the listener scores on speakers and microphones that speaker variability played some part, as might be expected. Table 1 gives the scores on the PB test words broadcast from the KC-97 and C-124 aircraft.

Table 1. Per cent Correct Scores on Broadcasts from the KC-97 and C-124 Aircraft. (8 Listeners)

KC-97

	Microphones					
	M-33		Ear		Bone	
Speaker	A	B	A	B	A	B
Quiet	90.0	84.3	83.8	80.5	74.5	82.3
Noise	78.9	68.3	71.7	67.7	59.7	77.4
Mean	84.4	76.3	77.8	74.1	67.1	79.9

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C-124

	Microphones					
	M-33		Ear		Bone	
Speaker	A	C	A	C	A	C
Quiet	89.4	91.7	80.3	79.4	75.1	71.7
Noise	80.6	75.1	74.9	57.2	53.1	50.0
Mean	85.0	83.4	77.6	68.3	64.1	60.9

Speaker "A" in the Table above, the Wing Chief pilot, took part in both the broadcasts. Speakers "B" and "C" were also chief pilots, the latter having a decided Southern American dialect. It is of interest to note that this speaker, who participated in the C-124 flight, was made comparatively much less intelligible than his companion with both mouth and ear microphones during playbacks of the stimuli in noise.

Inasmuch as the speakers in the KC-97 recording were operating in an ambient noise field of approximately 97 db and the auditors at the ground station were in comparative quiet, the results of the "QUIET" listening runs were considered as the closer approximation to ground listening conditions and these data were analyzed statistically. An analysis of variance, microphones x listeners, was performed, the results being given in Table 2, below.

Table 2. Analysis of variance: Three Microphones Used in the KC-97 Aircraft.

Source	df	SS	Est Var.	F	p point
Microphones	2	306.5	153.3	14.4	.01
Listeners	7	916.0	130.9	12.3	.01
Remainder	14	148.6	10.6		
Total	23	1371.13			

The critical mean difference of 4.80 applied to the KC-97 microphone means (M-33= 87.15, Ear= 82.15, Bone= 78.40) indicates that the M-33 produced scores significantly better at the 1% level of confidence, whereas no difference emerged between the ear and bone transducers.

A similar analysis performed on data from the C-124 transmissions, recorded in an ambient noise field of approximately 106 db, is given in Table 3.

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Table 3. Analysis of Variance: Three Microphones Used in the C-124 Aircraft.

Source	df	SS	Est. Var.	F	p point
Microphones	2	1066	533.0	14.33	.01
Listeners	6	490	81.7	2.20	
Remainder	12	446	37.2		
Total	20	2002			

A critical mean difference of 8.38 applied to the C-124 microphone means (M-33=90.6, Ear=80.0, Bone=73.3) indicates the M-33 produced scores significantly better than the experimental microphones at the 1% level of confidence, with the ear and bone tranducers again exhibiting no difference.

On a strictly statistical criterion, the M-33 microphone proved best in these tests. It is to be stressed, however, that these results are only a part of the performance evaluation and should be viewed as such. Again the point is made that gradations of difference as established on laboratory tests of isolated words may not override considerations of lightness, ease of use, and sanitation that must be considered in the operational use of equipment. The possibility also exists that the margin of difference as exhibited above might well vanish with the use of connected speech and the highly redundant phraseologies normally employed in traffic operations.

C. Reception Tests

1. The Problem

As mentioned in the introduction to this report the use of cumbersome, unsanitary headgear is particularly undesirable under conditions of hot-weather flying. This poses problems with exceptionally noisy aircraft such as the SA-16 flying boat. Noise levels upon takeoff, for instance, which run as high as 126 db, make normal interphone communication impossible, even with present equipment, furnishing as it does, some measure of noise exclusion by the circumaural cushion. It is obvious that, although the takeoff condition may last only thirty seconds, this period might well be critical for the safety of the aircraft, and therefore the takeoff reception problem merits special consideration. Much pilot interest had been shown in the possibility of using the insert receiver or bone contact unit to effect a successful substitute for the present headset.

2. Procedure

Because the SA-16 aircraft provided the worst listening conditions encountered at the base,[9] it was selected to try the effectiveness

of the ear and bone units as receivers. The same units could, of course, have been employed as transmitters had it been possible to obtain the SA-16 aircraft fitted with the AIC-10 circuit. Since none of these were available at the time of the test, the trials were limited to listening alone.

The pilot, co-pilot, and one of the experimenters, fitted with custom-built ear molds, were connected to the aircraft's interphone system with three of the miniature insert receivers used previously in the transmission tests as microphones. The T-17 carbon microphone was used in conjunction with the interphone system. Instructions and information were given and received over the system during runup, takeoff, and level flight with good readability. No objective evaluations of the receiver's efficiency were available under these communication circumstances, inasmuch as no recordings were made in the aircraft. In the opinion of the chief pilot in charge of SA-16 operations, however, the communication was excellent and the lightness of the receiver very desirable for such flying duty.

The bone receiver, while functioning better when positioned on the mastoid than at any other location, could not be considered a satisfactory device under conditions in which the ears could not be isolated from the noise. It is possible that the bone transducer would function satisfactorily in conjunction with some types of ear defenders, although this was not tried at the time of testing.

3. Discussion

Interviews with participating pilots and other flying personnel indicated that their requirements for an ideal headset-microphone combination would include satisfactory transmitting and receiving characteristics with no heavy or constricting equipment around the head to impede free sweating. Two-eared listening would be desirable, with at least one-eared listening possible at all times, even when transmitting.

III. CONCLUSIONS AND RECOMMENDATIONS

On the basis of this and other tests it is concluded that different kinds of flying assignments make any one headset-microphone combination a difficult, if not impossible, ideal. Whereas jet personnel may be satisfied with some sort of earmuff and associated headset due to their habitual use of head protection, equipment satisfactory for their use is entirely unsatisfactory for duty in hot, humid climates at comparatively low altitudes. The operational test of the ear and bone units used as microphones indicated performance equal to that presently used, with considerable relief from a point of view of weight and convenience. The ear insert functioned satisfactorily as a receiver, as well. It should be here pointed out that during these tests the ear microphone was furnished with the protection of an ear muff, a feature that would not be acceptable in operational use. Some modifications of the ear microphone have already been effected to increase the signal strength several db, a factor that may make it possible to both send and receive with the same unit without the use of any muff protection.

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The use of the bone transducer as a receiver without some isolation of the ears does not seem feasible.

Statistical comparisons of scores of tests on PB words under the conditions of these flights indicated a significant difference in intelligibility in favor of the present M-33 microphone, although the mean difference in test scores was comparatively small.

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7. Noise levels recorded on C-124 at microphone position in aircraft:

Scale (in db)

	A	B	C
Runup	100	88	104
Takeoff			104-106

Meter was H.H. Scott 410-B

8. This transistor amplifier, a Gates Transmote, has a potential of 78 db signal gain, weighs 3 lbs., and operates on 23 1/2 volts furnished by mercury cells. The maximum power was not necessary, only 20 db being utilized.

9. Noise levels measured in the cabin were 126 db on takeoff, 106 db in level flight. Readings were C scale measurements.

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Printed Reports Available from OTS Announced in This Issue

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fort reported herein centered on the establishment of an electrode geometry for stable operation, measurements of the temperature and velocity distribution in the tail flame at varying ambient pressures, and qualitative observations of the electrodynamic, magnetic and thermodynamic properties of the tail flame. The axial temperature distribution in the tail flame was measured by spectral line reversal technique for temperatures below 3200°K, and by spectral band analysis above this temperature. Flame velocity was measured by a modification of Schloff's method, involving a temporary interruption of the arc and observation of the downstream propagation of the resulting disturbance by high-speed cinematography. Surface heat flux rates were measured at 1.0 and 0.1 atmospheres on copper bodies in thermal equilibrium. Finally, diffusivity measurements were made in the tail flame on OFHC copper and graphite plates. AD 142093. Project 7360, Task 73603. Covers work from Apr 1956-Mar 1957. Contract AF 33(616)-3669. AF WADC TR 57-226.

Nonmetallic ferromagnetic materials: Part VI: Ferrite measurements program, by Robert E. Shultz, and Harold W. Katz. General Electric Company. Electronics Div., Syracuse, N.Y. Dec 1955. 102p photos, diagrs, graphs. Order from OTS. $2.75. PB 131039

In this report techniques for determining B-H relationships are discussed and a practical hysteresigraph is described. Large signal data for a number of commerical ferrites are presented. These data include: (1) reactive and real power, over a frequency range of 50 to 500 kc and a temperature range from room temperature to a point near the Curie temperature; (2) normal magnetization curves of several selected materials over a temperature interval of -70°C to the Curie temperature; (3) saturation flux density as a function of temperature for several selected materials. Low signal measurements of permeability, μ, quality factor, Q, and μ Q product are reported for a variety of materials. AD 110615. Project 4155, Task 41640. Covers work from Apr 1, 1943 - Oct 31, 1955 under Contract AF 3(616)-2009. For Parts 1-5, 7-8 see PB 121858, 121861, 121868 - 121869, 121874, 131052-131053. AF WADC TR 56-274, Part 6.

Operational tests of miniature microphones and receivers, by Henry M. Moser and John J. Dreher. Ohio State University Research Foundation, Columbus, O. Oct 1956. 13p tables. Order from LC. Mi $2.40, ph $3.30. PB 125761

Report of transmission and reception tests on an experimental model of a Telex # 3776 binaural headset and a modified M-32 microphone, which would offer relief from the weight and discomfort of standard sets. AD 98819. Project no. 7681. Contract AF 19(604)-1577. Technical report no. 30. OSURF Proj 664. AF CRC TN 56-57.

P-n junctions and their photoelectric properties. Final report for the period 15 Jun 1954 to 14 Jun 1955, under Contract DA 36-039-sc-64444, by Kurt Lehovec and John Coetly. Sprague Electric Company, North Adams, Mass. Jul 1955. 134p photos, diagrs, graphs, tables. Order from LC. Mi $6.90, ph $21.30. PB 126794

The work has been principally concerned with graded junctions prepared by melting and regrowing Ge-Si alloys on a Ge base. Polycrystalline alloy ingots have been used for this purpose. It has been shown that graded junctions having differences in Si content up to several percent can be prepared free of cracks. The following four experimental and theoretical problems have also been investigated in the course of this contract: (a) Electrical properties of grown germanium P-N junctions, by R. Zuleeg and H. Jackson. (b) Recombination radiation from germanium and silicon. (c) Theory of the magnetic rectifier. (d) Current-voltage characteristic and hole-injection factor of point-contract rectifiers in the forward direction.

QRC T-21 interference locator, by Edward Malowicki. U.S. Air Force. Air Research and Development Command. Rome Air Development Center, Griffiss Air Force Base, Rome, N.Y. Feb 1956. 52p photos, diagrs (part fold). Order from LC. Mi $3.60, ph $9.30. PB 126765

1. Radio interference - Locators 2. AF RADC TR 56-2.

Quadruped antenna, by H. Lottrup Knudsen. Denmark. Royal Technical University. Laboratory of Electromagnetic Theory, Copenhagen, Denmark. 1956. 34p diagrs, graphs. Order from LC. Mi $3.00, ph $6.30. PB 126212

This paper describes a circle-shaped antenna system composed of infinitely many, infinitely short antennas, a so-called ring quasi-array, which radiates such a field that the voltage induced in a linear antenna placed at a right angle to the direction to the antenna system will only to a small degree be dependent upon the direction to and the orientation of the linear antenna, when, in each case, the phase rotation of the currents in the ring quasi-array is so chosen (positive or negative) that the induced voltage will be as large as possible. Electrical Engineering Series, vol. 7, no. 4. Acta polytechnica 200.

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AD 91509. Project no. R-357-10-6. For reports no. 8 - 11, 13 - 14 under this Contract see PB 116802, 118093, 118465, 120152, 122956 and 123417. Includes Technical reports: 1. Millimeter and sub-

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Sept. 28, 1965 W. GÜTTNER ETAL 3,209,080

ELECTRICAL HEARING AID

Filed June 29, 1961

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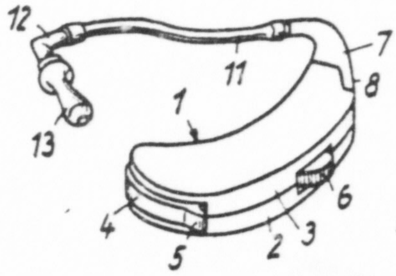

Fig.1

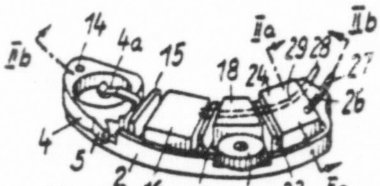

Fig.2

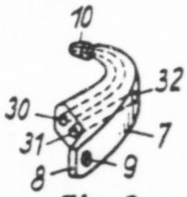

Fig.3

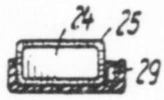

Fig.2a

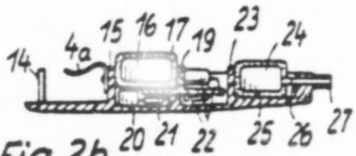

Fig.2b

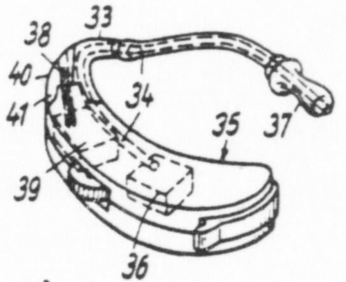

Fig.4

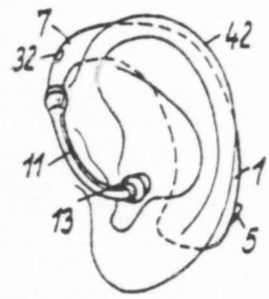

Fig.5

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Larkin Exhibit #38

United States Patent Office

3,209,080
Patented Sept. 28, 1965

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3,209,080
ELECTRICAL HEARING AID

Werner Güttner and Clemens Starke, Erlangen, and Franz Sapara, Erlangen-Bruck, Germany, assignors to Siemens-Reiniger-Werke Aktiengesellschaft, Erlangen, Germany, a corporation of Germany

Filed June 29, 1961, Ser. No. 120,640
Claims priority, application Germany, May 12, 1961, S 73,924
7 Claims. (Cl. 179—107)

This invention is concerned with an electrical hearing aid to be worn in back of the ear, comprising a housing containing electrical components including the micro-phone, amplifier with regulating elements, battery and receiver, and having a bookshaped carrier portion which is free of electrical components, preferably removably connected with the housing and attachable to the upper part of the auricle.

The housing of a hearing aid which is worn in this manner, is thus positioned in back of the ear while the carrier portion extends toward the front of the ear. Accordingly, the microphone, which is disposed in the housing, is at a place lying in back of the ear. The entry or inlet opening through which the sound comes to the microphone is thereby provided as close as possible to the microphone, that is, at a place of the housing which is in back of the ear below and remote from the hooklike carrier. The sound inlet opening, also referred to as the speak-in opening, is thus frontally largely shielded by the auricle and also by the head. This is a disadvantage because sound waves generated in the course of a conversation come to the person who is hard of hearing from the front and can be received and amplified only along a detour over a path extending in back of the ear.

The invention provides a hearing aid of the initially indicated kind, comprising means forming a sound-conducting line extending contiguous to the sound entry element of the microphone provided in the housing, such line extending to the end of the housing facing the carrier part and continuing in the carrier part or approximately parallel thereto to a microphone sound supply line which terminates in a preferably frontally visible sound inlet opening. This makes it possible that sound waves coming directly from the front can reach the microphone without going over a detour. The person hard of hearing is thus, with the use of the hearing aid according to the invention, in a better position to follow speech which a conversation partner directs at him from the front.

The hearing aid according to the invention comprises, in an exemplary embodiment, a carrier which contains in known manner an acoustic passageway forming the sound exit channel extending from the receiver to the ear piece. In addition, this carrier contains an acoustic passageway forming the sound inlet channel extending to the microphone, such latter channel terminating in the region of the greatest curvature in a frontally visible opening of the convex wall of the carrier. The carrier which is constructed in this manner is advantageously plugged to tubular studs extending respectively from the receiver sound exit line and the microphone sound inlet line forming parts of the housing. The fastening of the carrier on the housing is effected by means of an extension which may be screw connected to the housing.

The receiver is advantageously disposed in the housing about midway of the longitudinal extent thereof and the sound exit line to the ear piece is carried past a narrow side of the microphone which is positioned ahead of the receiver. The sound exit line extending from the receiver is formed by a tubular part which is flattened at least at the portion thereof which passes along the microphone.

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The flattened portion of this tubular part is thereby positioned in parallel with the narrow side of the microphone, thus providing for a space saving disposition of the sound exit line.

The various objects and features of the invention will appear from the description which will be rendered below with reference to the accompanying drawing showing in perspective representation and in sectional views examples of details of hearing aids constructed according to the invention.

FIG. 1 shows an embodiment of the hearing aid in perspective view;

FIG. 2 shows the housing with the cover detached therefrom;

FIGS. 2*a* and 2*b* show sectional views taken respectively along lines II*a*—II*a* and II*b*—II*b* in FIG. 2;

FIG. 3 shows the carrier part of the hearing aid illustrated in FIG. 1;

FIG. 4 shows in perspective view an embodiment of a hearing aid wherein the carrier is made of two parts, one part containing only the sound exit line extending from the receiver to the ear piece, while the other part contains the sound inlet line extending to the microphone; and

FIG. 5 shows a hearing aid made in accordance with the invention in its position in connection with the ear.

The acurately shaped housing 1 which is made of synthetic material is constructed of two shells 2 and 3. The housing contains a drawer 4 for receiving the battery, such drawer being pivotally journalled at 14 and being provided with a handle 5. From the convex outer wall of the housing extends part of the sound volume adjusting member 6. At the end of the housing 1 opposite the pivoted drawer 4 is disposed the carrier 7 which is curved booklike and has an extension 8 provided with a hole formed therein (FIG. 3) through which a screw is projected for firmly fastening the carrier to the housing. The carrier terminates in a nipple 10 (FIG. 3) to which is attached a flexible hose 11 carrying an angular member 12 which in turn carries the flexible ear piece 13 to be inserted into the aural opening of the ear.

FIG. 2 shows the shell 2 of the housing with the component parts as they become visible after removal of the shell 3 and detachment therefrom of the carrier 7. Adjacent the battery drawer 4 is a partition 15 carrying the contact spring 4*a*, followed by the receiver 16 which is wrapped in foam rubber 17 (FIG. 2*b*). Next to the receiver 16 and partially thereunder are disposed parts of the amplifier 18. The amplifier parts, including also the volume control with the regulator 6, are mounted on a bracket 19. Below the bracket 19, and fastened thereto, are positioned capacitors and resistors which are schematically indicated respectively at 20 and 21, and at the portion of the bracket 19 which is next to the telephone 16, are positioned transistors 22 (FIG. 2*b*). Next to a partition 23, which delimits the amplifier space, is disposed the microphone 24 which is wrapped in foam rubber 25.

From the microphone 24 extends an acoustic passageway or sound inlet line 26 terminating in a tubular part 27 which projects from the housing. From the receiver 16 extends an acoustic passageway or sound exit line 29 which terminates in a tubular part 28, the latter likewise projecting from the housing. The sound exit line 29 which extends from the receiver 16 to the tubular member 28 is of oval cross-section at the portion thereof which passes along the microphone 24 (see FIG. 2*a*). The carrier 7 through which extend the sound channels 30 and 31, as shown in FIG. 3, is plugged to the tubular connecting members 27 and 28. The sound exit channel 30 extends to the nipple 10 to which is connected the flexible hose 11 leading to the ear piece 13, and the sound inlet channel 31

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(for the microphone 24) terminates in the sound inlet opening 32.

The hearing aid illustrated in FIG. 4 corresponds substantially to the hearing aid described with reference to FIGS. 1 to 3. The only difference resides in the construction of the carrier, indicated in FIGS. 1 and 3 at 7, which in FIG. 4 is made in two parts, one part 33 containing only the sound exit channel 34 leading from the receiver 36 to the ear piece 37. The sound inlet channel 38 leading to the microphone 39 extends through the other part 40 which is fastened to the housing 35 by means of an extension 41. The part 40 can also be constructed as a tube which is screw connected with the connecting tube 27 (FIGS. 2 and 2*b*), it being of course assumed that appropriate threads are provided for this purpose.

As will be seen from FIG. 5, the housing (1 in FIG. 1 or 35 in FIG. 4) is in operation positioned in back of the ear 42 while the carrier 7 (33, 40 in FIG. 4) extends forwardly of the ear 42. The sound inlet opening 32 (opening of inlet channel 38 in FIG. 4) thus comes to lie at a point which is in the use of the hearing aid directed toward the front. Sound waves directed toward the person wearing the hearing aid can accordingly directly enter at the sound inlet opening such as 32 for direct propagation without any detour, to the microphone 24 over the lines 31 and 26 (FIGS. 2 and 3) or to the microphone 39 over the line 38 (FIG. 4). The microphone converts the sound waves into electrical signals which are amplified in the amplifier such as 18 (FIG. 2) and made audible again in the receiver such as 16 in FIG. 2 or 36 in FIG. 4. The amplified sound waves are in FIGS. 1–3 conducted to the aural passage of the ear 42 over the line 29, channels 30, 11, and through the ear piece 13, while being in FIG. 4 conducted to the aural passage over the lines 34 and the ear piece 37.

Changes may be made within the scope and spirit of the appended claims which define what is believed to be new and desired to have protected by Letters Patent.

We claim:

1. An electrical hearing aid comprising a housing constructed to be disposed and worn behind the ear, said housing containing components including a battery, a microphone, an amplifier with regulation means and a receiver, a hooklike curved carrier free of electrical components, which is to be worn upon the upper part of the auricle, means forming an elongated tubular acoustic passageway for conducting sound waves from exteriorly the housing to said microphone, said acoustic passageway terminating at its outer end in a frontally directed opening near the upper part of the auricle when the hearing aid is worn, with said acoustic passageway extending rearwardly over the auricle to said microphone.

2. An electrical hearing aid comprising a housing constructed to be worn behind the ear, said housing containing components including a battery, a microphone, an amplifier with regulation means and a receiver, a hooklike curved carrier free of electrical components, which is to

be worn upon the upper part of the auricle, means for removably connecting said carrier with said housing, said housing having an elongated tubular acoustic passageway formed therein for conducting sound waves to said microphone, said carrier having an elongated tubular acoustic passageway formed therein communicating at its connection end with the free end of said first-mentioned passageway, and terminating at its opposite end in a frontally directed and frontally visible sound inlet opening, said second-mentioned passageway extending rearwardly over the auricle to said first-mentioned passageway.

3. A hearing aid according to claim 2, comprising a bracketlike portion extending from said carrier for mounting the carrier in assembly with the housing.

4. A hearing aid according to claim 2, wherein said second-mentioned acoustic passageway terminates in a sound inlet opening in the portion of the wall of said hook-like carrier which has the greatest convex curvature, said carrier also having a tubular acoustic passageway formed therein which communicates at one end, with the receiver and at the opposite end with the ear piece of the device.

5. A hearing aid according to claim 4, comprising means forming a tubular acoustic passageway for conducting sound waves from said receiver, tubular studs extending from the housing and communicating respectively with the line to said microphone and the line from said receiver, said studs extending in assembled position of said carrier into the respective acoustic passageways formed therein.

6. A hearing aid according to claim 4, wherein the receiver is disposed in said housing within a centrally extending region thereof while the microphone is disposed therein near the end thereof facing said carrier, and means forming an acoustic passageway extending from said receiver alongside a narrow side of said microphone to the ear piece of said hearing aid.

7. A hearing aid according to claim 6, comprising a tubular member disposed in said housing and forming said acoustic passageway from the receiver, said tubular member being flattened at least for the portion thereof which passes along the narrow side of said microphone, with the long cross sectional axis of said flattened portion extending in parallel with said narrow side.

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ROBERT H. ROSE, *Primary Examiner.*

STEPHEN W. CAPELLI, *Examiner.*

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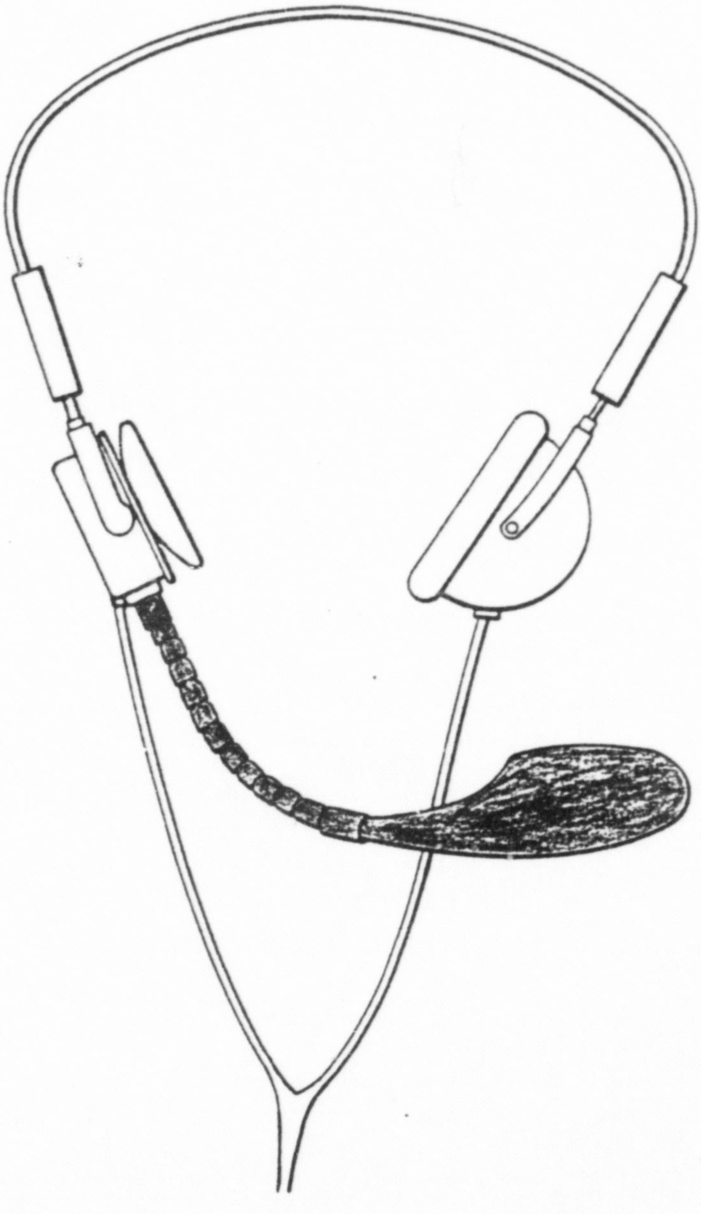
716,801 PROVISIONAL SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

FIG. 4.



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DEFENDANT'S EXHIBIT
NO. C (Tab 9)

P.I. File
Plantronics Headset

FIG. 1.

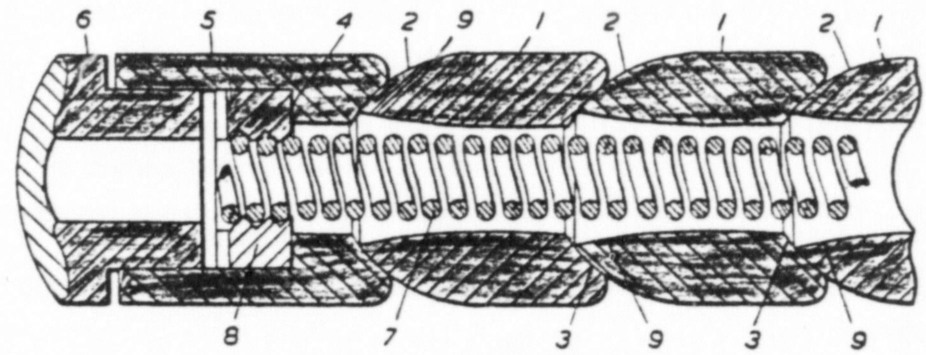


FIG. 2.

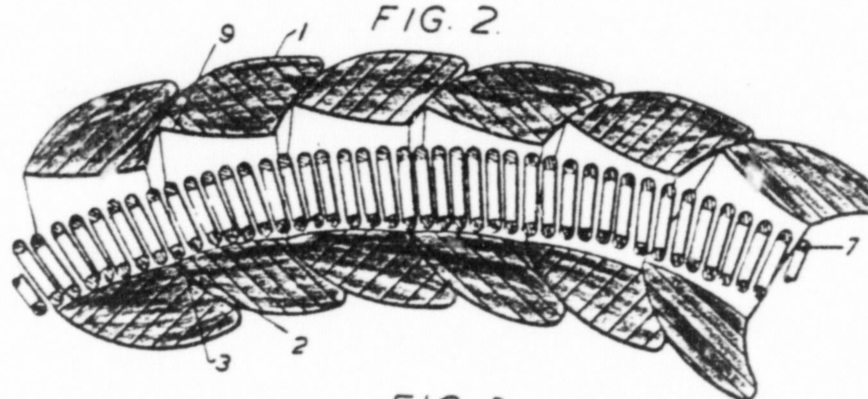
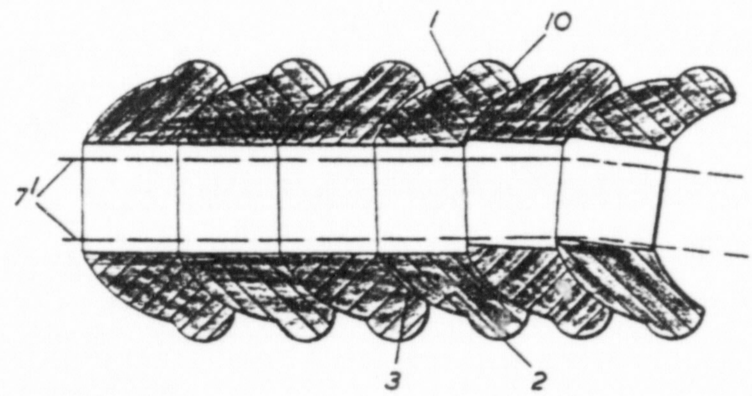


FIG. 3.



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PATENT SPECIFICATION

Inventors: JAMES SAMUEL PATERS[illegible]RTSON and EDWIN JOHN SHELTON

716,801

Date of filing Complete Specification Oct. 24, 1952.

Application Date Nov. 6, 1951. *No. 25949/51.*

Complete Specification Published Oct. 13, 1954.

Index at acceptance:—Classes 13, 13C; 40(4), J(3A: 4D); 40(8), Y(4: 5); 99(2), E1A; and 118(2), H.

COMPLETE SPECIFICATION

Acoustic Duct for Electro-Acoustic Transducer

We, STANDARD TELEPHONES AND CABLES LIMITED, a British Company, of Connaught House, 63 Aldwych, London, W.C.2, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to acoustic devices comprising acoustic ducts.

According to the invention there is provided an acoustic device comprising a flexible acoustic duct incorporating a plurality of identical unitary hollow nesting segments, contiguous surfaces of which are shaped so as to maintain continuous annular contact between adjacent segments over a predetermined range of relative movement of adjacent segments with means passing through the duct for maintaining the segments in axial compression one against another.

It is frequently required to operate an electroacoustic transducer at some little distance from the origin of the sounds or the place where the sound is to be delivered according to whether the transducer is of the microphone or the receiver type, and it is proposed to use a flexible duct for the purpose.

Flexible metallic tubing of the ordinary type may be used, but is inclined to be heavy, especially when it is of the "[illegible] put" type which will retain the form into which it is bent.

It has been found that a tube made up of separate nesting segments, held together by the endwise tension of a spring or the like has many advantages as an acoustic duct.

The invention will be described in relation to certain embodiments developed for use with a telephone operator's headset where it is proposed to mount the microphone on the head band and to provide an adjustable acoustic duct terminated by a small mouthpiece for sound transfer from the mouth to the microphone. These embodiments are illustrated in the drawings accompanying the provisional specification in which:—

Fig. 1 shows a longitudinal cross section of a duct of segmented type with one kind of segment, and shows the method of securing an internal tensioning spring;

Fig. 2 shows a longitudinal cross section of a part of a duct of segmented type using another kind of segment.

Fig. 3 shows a longitudinal cross section of a duct of segmented type using yet another kind of segment; and

Fig. 4 shows a telephone operator's head-set using a duct of the type illustrated in Fig. 1 for conveying speech from the operator's mouth to a microphone secured against the head.

In Fig. 1 a segmental duct is made of a number of hollow cylindrical segments each having one end 2 shaped to the form of a part of a convex sphere and the other end 3 hollowed out in the shape of part of a concave sphere. The convex end of one segment nests into the concave end of the next one and all are held together by a coiled spring 7 running down the central bore of the segments and secured at each end by a nut 8 threaded internally to grip the convolutions of the spring and bearing against an internal shoulder 4 of a special end piece 5 which may be bored out to form a socket for attachment of the transducer at one end or the sound outlet or collector at the other end. The figure shows part of a ferrule 6 fitting into 5 for such attachments. The nesting faces of the segments permit movement in directions normal to the axes of the segments, the segments swivelling in relation to one another within limits set by the internal spring which arrests further movement when it bears against one segment at one side and the adjoining segment at the diametrically opposite

[*Price 2/8*]

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side, in the region of the junction between two segments.

To allow the maximum flexibility, the internal bores of the segments may be widened at one or both ends as shown at 9.

The greater the tension of the spring 8, the greater the friction between nesting faces of adjacent segments and the better does the duct retain the shape into which it is bent.

Fig. 2 shows a part of a segmented duct using axially shorter segments which enable smoother bends to be made. Corresponding items in the figure and in Figs. 1 and 3 are given the same reference numerals.

In Fig. 3 segments even shorter than those of Fig. 2 are shown and in addition each segment has a circumferential rib 10 at the concave end which stiffens this end to resist any tendency for it to open out under the endwise pressure of the spring forcing the convex end of the adjacent segment into it. The rib also limits the bending movement of segments relative to one another which has certain advantages when sharp bends are made since any tendency for one pair of segments to take more than its fair share of the angular displacement is resisted.

The shorter the segments, the less tendency there is to trap the spring and the opening of the ends of the bores of the segments may be omitted. As there is also less tendency for the trapping of the spring to limit the relative movement of the segments, it is sometimes necessary to have ribs such as 10, for this reason alone.

The relative movement of segments must not be allowed to reach the point at which the bore of one segment is uncovered by the adjacent segment allowing the duct to leak to the surrounding air.

In Fig. 3 the spring 7 is shown in outline only by parallel dotted lines 7'.

The acoustic characteristics of acoustic ducts are such that sounds passing down them are subjected to amplitude frequency distortion, that is to say some frequencies are boosted and others attenuated. This effect grows with a shortening of the duct and *vice versa*.

When, for any length of duct, this distortion cannot be tolerated it may be considerably minimised by introducing acoustic resistance into the duct.

When ordinary flexible stay-put tubing is used for the duct, resistance may be introduced into the bore in a variety of ways such as packing with wadding or inserting a roll of fine gauze. If wire gauze is used the flexibility of the tube is somewhat impaired and the gauze must be placed where sharp bends are not required.

It has been found in the case of segmented ducts of the type shown in Figs. 1, 2 and 3, that this resistance can be furnished by the spring 7 if it is of the correct form.

The best results are obtained if the spring is smaller in over-all diameter than the internal bore of the segments so that air waves pass along the spring inside and outside. The closer the coils of the spring, the greater the resistance so long as they are not actually touching one another. The resistance is caused by skin friction of the air in passing over the surface of the spring coils and anything which increases the area of this surface increases the acoustic resistance.

It is known, in an operator's headset to use a miniature microphone mounted on an adjustable boom secured to the receiver or to the end of the head harness opposite to the one to which the receiver is secured. It is difficult with this arrangement to avoid disturbing the adjustment of the boom when the head is moved due to the inertia of the microphone.

It is now proposed to fix the microphone to the head harness and extend the sound inlet by means of a flexible duct terminating in a flare opposite the mouth. Fig. 4 shows this arrangement with a segmented duct.

The duct must be flexible so that it can be adjusted to suit the individual operator and it must be of the "stay-put" type so that it will retain its adjustment. Unless the duct is made of light weight materials, it is liable to lose its adjustment in the same way as the boom-mounted microphone, when the head is moved. Most commercial flexible metallic tubing of the stay-put type is apt to be objectionable on this score and a special lightweight tubing should be used. On the other hand a segmented duct made in the manner described above can be made very light especially if suitable materials are used. Polyethylene has been used successfully.

In an operator's headset of this type the amplitude/frequency distortion due to the duct may be damped as mentioned above by the introduction of wadding, gauze or the like into the duct, if it is of ordinary flexible tubing, but if a segmented duct of the types described, is used adequate damping is provided by the presence of the tensioning spring. For some requirements additional damping may be necessary and it could be introduced into the air passages of the microphone with which the duct communicates. A roll of fine wire gauze answers this purpose well

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though there are many alternatives. The microphone of the headset shown in Fig. 1 has a cylindrical passage running diametrically across and over the diaphragm. The bore of this passage intersects the flat face of the cover which encloses the space over the diaphragm so as to leave a slit across the width of the diaphragm through which this space communicates with the cylindrical passage. Extra damping in the form of a roll of gauze has been introduced into this cylindrical passage with success.

In the application illustrated in Fig. 1, using a segmented duct of the type described the following dimensions for the duct are recommended as giving a suitable combination of lightness, mechanical strength and transmission characteristics:—

	inches
Over-all diameter of segments	.437
Diameter of bore of segments at the narrowest point -	.187
Over-all diameter of tensioning spring - - - -	.144
Spring wire diameter - -	.031
Radius of curvature of nesting faces of segment - -	.218

Overall length of segment

Fig. 1 type - -	.45 inches
Fig. 2 type - -	.3 inches
Fig. 3 type - -	.25 inches

The Fig. 1 type segments, being fewer per unit length of duct make for a cheaper article and are suitable when the bends required are not sharp.

The shorter segments of Figs. 2 and 3 give greater flexibility and better retention of shape as there is less tendency to subject the spring to sharp localised bends than with the Figure 1 type. The increased number of segments per unit length of duct will raise the cost however.

It is desirable to use a material with a high coefficient of friction, where absolute retention of adjustment is required and this property is improved by increasing the tension of the spring.

A stiff spring is to be preferred where maximum damping is required as a spring requiring considerable extension to give adequate tension has more open convolutions and presents less wire surface for the air stream to pass over.

What we claim is:—

1. An acoustic device comprising a flexible acoustic duct incorporating plurality of identical unitary hollow nesting segments, contiguous surface of which are shaped so as to maintain continuous annular contact between adjacent segments over a predetermined range of relative movement of adjacent segments with means passing through the duct for maintaining the segments in axial compression one against another.

2. A device as claimed in claim 1 in which the said compression maintaining means comprise an extensible member over which the segments are threaded, the member being anchored in longitudinal tension at both ends of the duct.

3. A device as claimed in claim 2 in which the extensible member is a helical spring.

4. A device as claimed in any one of the preceding claims in which one of two adjacent segments of the duct has an end of convex part-spherical form and the other of the two adjacent segments has an end of concave part-spherical form the convex end of the one segment engaging the concave end of the other segment.

5. A device as claimed in any one of the preceding claims in which at least one of each pair of adjacent segments of the duct is made of a material having a high coefficient of friction whereby the duct tends to retain the shape to which it is bent.

F. JOHN PRIOR,
Chartered Patent Agent,
For the Applicants.

PROVISIONAL SPECIFICATION

Acoustic Duct for Electro-Acoustic Transducer

We, STANDARD TELEPHONES AND CABLES LIMITED, a British Company, of Connaught House, 63 Aldwych, London, W.C.2, England, do hereby declare this invention to be described in the following statement:—

This invention relates to acoustic ducts for electro-acoustic transducers, and to telephone operators' headsets. One aspect of the invention is to mount the microphone of a telephone operator's headset on the head band and to provide an adjustable acoustic duct terminated by a small mouthpiece sound transfer from the mouth to the microphone.

For this and for other purposes it is frequently required to operate an electro-acoustic transducer at some little distance from the origin of the sounds or the place where the sound is to be delivered according to whether the transducer is of the microphone or the receiver type, and it is proposed to use a flexible duct for the purpose.

Flexible metallic tubing of the ordinary type may be used, but is inclined to be heavy, especially when it is of the "stay put" type which will retain the form into which it is bent.

It has been found that a tube made up

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of separate nesting segments, held together by the endwise tension of a spring or the like has many advantages as an acoustic duct.

The invention will be described in relation to certain embodiments illustrated in the accompanying drawings in which:—

Fig. 1 shows a longitudinal cross section of a duct of the segmented type with one kind of segment, and shows the method of securing an internal tensioning spring;

Fig. 2 shows a longitudinal cross section of a part of a duct of the segmented type using another kind of segment.

Fig. 3 shows a longitudinal cross section of a duct of the segmented type using yet another kind of segment; and

Fig. 4 shows a telephone operators' head-set using a duct of the type illustrated in Fig. 1 for conveying speech from the operator's mouth to a microphone secured against the head.

In Fig. 1 a segmented duct is made of a number of hollow cylindrical segments each having one end 2 shaped to the form of a part of a convex sphere and the other end 3 hollowed out in the shape of part of a concave sphere. The convex end of one segment nests into the concave end of the next one and all are held together by a coiled spring 7 running down the central bore of the segments and secured at each end by a nut 8 threaded internally to grip the convolutions of the spring and bearing against an internal shoulder 4 of a special end piece 5 which may be bored out to form a socket for attachment of the transducer at one end or the sound outlet or collector at the other end. The figure shows part of a ferrule 6 fitting into 5 for such attachments. The nesting faces of the segments permit movement in directions normal to the axes of the segments, the segments swivelling in relation to one another within limits set by the internal spring which arrests further movement when it bears against one segment at one side and the adjoining segment at the diametrically opposite side, in the region of the junction between two segments.

To allow the maximum flexibility, the internal bores of the segments may be widened at one or both ends as shown at 9.

The greater the tension of the spring 8 the greater the friction between nesting faces of adjacent segments and the better does the duct retain the shape into which it is bent.

Fig. 2 shows a part of a segmented duct using axially shorter segments which enable smoother bends to be made. Corresponding items in this figure and in Figs. 1 and 3, are given the same reference numerals.

In Fig. 3 segments even shorter than those of Fig. 2 are shown and in addition each segment has a circumferential rib 10 at the concave end which stiffens this end to resist any tendency for it to open out under the endwise pressure of the spring forcing the convex end of the adjacent segment into it. The rib also limits the bending movement of segments relative to one another which has certain advantages when sharp bends are made since any tendency for one pair of segments to take more than its fair share of the angular displacement is resisted.

The shorter the segments, the less tendency there is to trap the spring and the opening of the ends of the bores of the segments may be omitted. As there is also less tendency for the trapping of the spring to limit the relative movement of the segments, it is sometimes necessary to have ribs such as 10, for this reason alone.

The relative movement of segments must not be allowed to reach the point at which the bore of one segment is uncovered by the adjacent segment allowing the duct to leak to the surrounding air.

In Fig. 3 the spring 7 is shown in outline only by parallel dotted lines 7'.

The acoustic characteristics of acoustic ducts are such that sounds passing down them are subjected to amplitude frequency distortion, that is to say some frequencies are boosted and others attenuated. This effects grows with a shortening of the duct and *vice versa*.

When, for any length of duct, this distortion cannot be tolerated, it may be considerably minimised by introducing acoustic resistance into the duct.

When ordinary flexible stay-put tubing is used for the duct resistance may be introduced into the bore in a variety of ways such as packing with wadding or inserting a roll of fine gauze. If wire gauze is used the flexibility of the tube is somewhat impaired and the gauze must be placed where sharp bends are not required.

It has been found in the case of segmented ducts of the type shown in Figs. 1, 2 and 3, that this resistance can be furnished by the spring 7 if it is of the correct form.

The best results are obtained if the spring is smaller in over-all diameter than the internal bore of the segments so that air waves pass along the spring inside and outside. The closer the coils of the spring the greater the resistance so long as they are not actually touching one another. The resistance is caused by skin friction of the air in passing over the surface of the spring coils and anything which

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increases this area increases the acoustic resistance.

It is known, in an operator's headset to use a miniature microphone mounted on an adjustable boom secured to the receiver or to the end of the head harness opposite to the one to which the receiver is secured. It is difficult with this arrangement to avoid disturbing the adjustment of the boom when the head is moved due to the inertia of the microphone.

It is now proposed to fix the microphone to the head harness and extend the sound inlet by means of a flexible duct terminating in a flare opposite the mouth. Fig. 4 shows this arrangement with a segmented duct.

The duct must be flexible so that it can be adjusted to suit the individual operator and it must be of the "stay-put" type so that it will retain its adjustment. Unless the duct is made of light weight materials, it is liable to lose its adjustment in the same way as the boom-mounted microphone, when the head is moved. Most commercial flexible metallic tubing of the stay-put type is apt to be objectionable on this score and a special lightweight tubing should be used. On the other hand a segmented duct made in the manner described above can be made very light especially if suitable materials are used. Polyethylene has been used successfully.

In an operator's headset of this type the amplitude/frequency distortion due to the duct may be damped as mentioned above by the introduction of wadding, gauze or the like into the duct, if it is of ordinary flexible tubing, but if a segmented duct of the types described, is used, adequate damping is provided by the presence of the tensioning spring. For some requirements additional damping may be necessary and it could be introduced into the air passages of the microphone with which the duct communicates. A roll of fine wire gauze answers this purpose well though there are many alternatives. The microphone of the headset shown in Fig. 4 has a cylindrical passage running diametrically across and over the diaphragm. The bore of this passage intersects the flat face of the cover which encloses the space over the diaphragm so as to leave a slit across the width of the diaphragm through which this space communicates with the cylindrical passage. Extra damping in the form of a roll of gauze has been introduced into this cylindrical passage with success.

In the application illustrated in Fig. 4, using a segmented duct of the type described the following dimensions for the duct are recommended as giving a suitable combination of lightness, mechanical strength and transmission characteristics:—

	inches
Over-all diameter of segments	.437
Diameter of bore of segments at the narrowest point -	.187
Over-all diameter of tensioning spring - - - - -	.144
Spring wire diameter - -	.031
Radius of curvature of nesting faces of segment - -	.218
Overall length of segment	
Fig. 1 type - -	.45 inches
Fig. 2 type - -	.3 inches
Fig. 3 type - -	.25 inches

The Fig. 1 type segments, being fewer per unit length of duct make for a cheaper article and are suitable when the bends required are not sharp.

The shorter segments of Figs. 2 and 3 give greater flexibility and better retention of shape as there is less tendency to subject the spring to sharp localised bends than with the Figure 1 type. The increased number of segments per unit length of duct will raise the cost however.

It is desirable to use a material with a high coefficient of friction, where absolute retention of adjustment is required and this property is improved by increasing the tension of the spring.

A stiff spring is to be preferred where maximum damping is required as a spring requiring considerable extension to give adequate tension has more open convolutions and presents less wire surface for the air stream to pass over.

With ducts of normal stay-put flexible tubing the size is not critical acoustically and ease of manufacture and the need for lightness will be the governing considerations. For instance, a bore of about 1/8th of an inch would be adequate acoustically but it would be difficult to manufacture a flexible tube of the size which had adequate stay-put characteristics. There might also be difficulty in introducing gauze or the like into a tube as small as this but damping could be furnished by inserting a spring slightly opened but not under tension to provide resistance in the same way as in the case of segmented ducts. An overall diameter of about half an inch would be desirable for ease of manufacture but would probably be too heavy.

F. JOHN PRIOR,
Chartered Patent Agent,
For the Applicants.

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PPI ADS* & SALES FLYERS**

* Includes sample PPI ads and new product articles prior to August of 1964

** Includes PPI sales flyers on its MS-55 and MS-56 earmuff headsets and its PAC-1 acoustic coupler

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Santa Cruz Sentinel
Aug. 6, 1961

Santa Cruzans Offer New Idea For Airline Pilots

8-6-61

By Wally Trabing

An eight-month-old venture by a group of young Santa Cruz area men whose mental energy is being expended on research and development is on the verge of paying off.

A pilot's sending and receiving radio unit, built into a pair of glasses frames has been developed by the group, organized under the name of Plantronics, Inc., and presently located at 2800 Hillcrest avenue, near the West Foods Mushroom plant.

The five-ounce set, developed mainly for use in jet aircraft like the Boeing 707, the Douglas DC-8 and military jet aircraft is presently being tested by United Airlines.

In the meantime this inventive group has struck out in another direction to develop what they claim is a lighter, more efficient, and less expensive golf cart.

But their radio headset may be the first in production. Keith Larkin, Plantronics president, said the new set will enable more freedom for the pilot. Pilots now must use a hand mike for their transmissions, he said.

These units fit on the pilot's head like a pair of glasses. The frames are made so that any type of lens may be fitted to them, or they can be worn without lenses.

The electronics involved in sending and receiving are inside the side frames. An acoustical tube curves around to one corner of the mouth. This serves as a microphone. A tiny speaker fits into the ear.

The unit can easily be adapted to the oxygen mask for high altitude flying, Larkin said. He said present mask mikes make it difficult for the pilot's words to be understood.

"Our new mike cuts this distortion," he said.

Other officers of the corporation are: Court Graham, United Airlines pilot, vice president; Roland West of West Foods, vice president; Joseph Henderson, San Jose attorney, secretary; Charles D. Burnell, former real estate counselor, treasurer.

Larkin was former president of the Larkin Aircraft company and now lives at 74 Hollins drive.

He said plans are under way to construct a permanent plant soon on River street near the business district bypass.

Another phase of their development is a gas engine golf cart with an improved type of power transmission. Larkin said the cart weighs under 400 pounds. Most of those now in use weigh twice that. They expect to retail it at $695.

Radio For Airline Pilots

8/6/61

Keith Larkin, president of the Plantronics corporation, models a new development in sending and receiving radios for airline pilots. The entire unit is encased in these glasses. Any type of lens can be adapted to the frames. The mike is contained in the black tube which curves around to the corner of the mouth. The earphones are reduced to a tiny plug in the ear. This unit is presently being tested by United Airlines.

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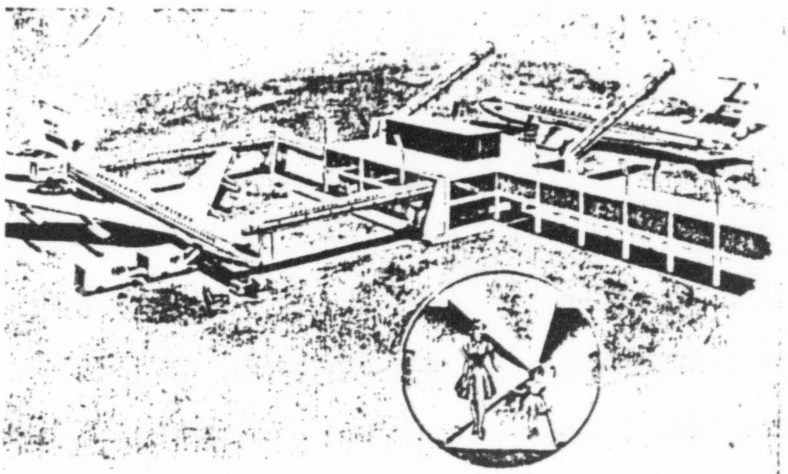

TUBULAR WALKWAY (See Loading Bridge below) will be used by Continental Air Lines for loading jets at Chicago's O'Hare Int'l Airport.

noise suppressor for Pan American's 707s and DC-8s. The unit has been dubbed a "universal" device since it is designed to fit all jet aircraft currently operated by international carriers.

An accessory "add-on" unit also has been developed, to provide additional sound suppression. Use of the "add-on" unit may eliminate the need for blast fences.

In another area of noise research, Industrial Acoustics Co. has devised a transistorized *Spectrometer* sound level meter and octave band analyzer which weighs four lbs. The instrument spans the intensity range from 24 to 140 db (reference: 0.0002 dynes/cm²) and the frequency range from 37.5 to 9600 cps.

Loading Bridge

Continental Airlines has revealed a plan for tubular walkways which will move passengers between jet aircraft and the carrier's new gatehouse at O'Hare Field in Chicago.

The 80-ft. long tubular walkways will be constructed of high-strength aluminum alloy. With a diameter of 8½ ft., the walkways will be capable of being raised to a 35-deg. angle, lowered to the ground, or swung in a 20-ft. arc. Six feet of the walkway will telescope at the aircraft end to permit precise aircraft mating.

The walkways were designed for Continental by Wagner-Morehouse, Inc., of Los Angeles. Unit is priced at $40,000.

Light Flashers

Compact, lightweight, transistorized position light flashers are being offered by Scintillonics, Inc. for use as wing tip lights or for similar applications.

Series 261 flashers are 4x4¼x1½ in. and weigh 9 oz. They are built to flash two 40-watt loads alternately and independently of each other. They have no moving parts, will not create radio interference, and are fail safe. Price: $34.50.

Jet Thrust Indicator

Accurate measurement of jet thrust is made possible by an Industrial Acoustics' instrument which measures the noise output of a jet engine and correlates the sound to the engine's thrust. This company's Ground Jet Thrust Indicator can be used for measurement of jet engine thrust under virtually all operating or test conditions.

Model JTI-P also can be adapted for other applications, serving as general malfunctioning detector or diagnostic instrument. The unit weighs less than seven lbs.

Minitel Headset

A miniaturized and ultra-lightweight aviator's headset and microphone combination called "Minitel" has been developed by Plantronics, Inc., a newly organized company in Santa Cruz, Calif., to meet requirements of modern transport aircraft and high density traffic considerations. United Air Lines is conducting studies on it in a test installation in the DC-8.

All components are mounted to and within a capsule which is designed for snap-on attachment to either left or right bow of conventional sunglass frames equipped with G-15 Ray Ban lenses which are removable and/or pivot upward.

This unitized design replaces the three more cumbersome units currently used: (1) HS-33 headset and cord; (2) Hand-held microphone and cord; (3) Oxygen or smoke mask microphone, amplifier and cord.

In addition to greater comfort and convenience, the Minitel is described as offering these primary advantages with respect to safety: (1) Frees both hands to perform routine functions in the cockpit simultaneously with radio transmissions; (2) Mechanical time involved is reduced by 30%; (3) Ambient cockpit noise is substantially reduced and intelligibility increased through acoustical features of sound tube; (4) Cockpit cordage is reduced by 80% through use of a single cord and overhead jack attachment; (5) Sunglass frame type of mounting provides ease of stowage and immediate adaptability to light or dark conditions through use of swiveling and detachable lens.

The MS-50, one of two models proposed, has been developed specifically for use in Boeing and Douglas jet aircraft and offers the unique feature of the oxygen mask mechanical microphone. But it also is adaptable for installation in piston aircraft. The Model-51, currently in final stages of research and development, will be marketed at a lower price due to utilization of a single unit trans-

PHOTO ILLUSTRATES how MS-50 microphone and headset combination is used in conjunction with oxygen mask at high altitudes.

mitter-receiver performing essentially the same function as the MS-50, but not being adaptable to the oxygen mask microphone.

Refueler

An International Model CO-214 refueler truck leased to United Air Lines will be operated by Standard Oil in servicing United's jets at Cleveland's Hopkins Field airport.

Wheelbase of the refueler is 181¾ in. Tank capacity is 4400 gals. Heavy-duty brakes, an air tank reservoir for air-operated refueling equipment, and relocated muffler and circuit switches are additional features.

PRODUCT BRIEFS

Beverage container—British European Airways has purchased a quantity of beverage containers manufactured by the Aviation Services Dept. of the Lighting and Heating Group, General Electric Co., Ltd. The containers will be used on De Havilland Trident aircraft.

Test bench—Convair 990 autopilot checkout will be accomplished with a new test bench built for American Airlines by Seismograph Service Corp., Tulsa, and installed at American's Tulsa maintenance base.

Turbo-starter—Boeing has begun production of Turbo-Starter ground support unit featuring new 205 air horsepower compressor mounted in the rear of a Ford panel truck.

Exit light—Emergency exit light, powered by four flashlight cells and activated by a "G-switch," has been developed by Grimes Mfg. Co. and purchased for use by Delta Air Lines. The 7½-in. unit—Grimes 10-0012—is adaptable to all aircraft.

Locator beacon—An automatic crash locator beacon for either land or water use has been designed by George Harmon Co. Unit is discharged after sensing a predetermined impact force. While still in trajectory, transmitter is actuated, flotation bag inflated, ground stand extended,

Santa Cruz Sentinel
April 6, 1962

New Plantronics Headset Shown At NY Meeting

A lightweight radio microphone headset devised by Plantronics, Inc., of Santa Cruz was the subject of a formal presentation before a national aeronautics meeting in New York City today.

Dr. Arnett Dennis of Stanford Research institute presented a paper on Plantronic's MS-50 microphone headset combination.

The presentation was requested by Guggenheim Flight Safety foundation.

The headset, weighing less than one ounce, is designed for use in commercial and military aircraft, with possible space applications.

A tiny acoustically engineered sound tube provides greater fidelity than standard headsets. The Plantronics unit gives a pilot complete freedom to perform normal or emergency cockpit functions.

Plantronics, Inc., has research facilities at 111 Josephine street. It was incorporated in May, 1961, and first offered stock to the public September 20.

757 #5

Larkin Exhibit #38

11-7-73 MJ

[illegible] now offers to the [illegible]

. . . the

MS-30/T-30

Microphone-Receiver
With Control
Wheel Mounted
Push-To-Talk
Switch . . .

. . . and the

MS-20/T-30

Microphone only

It is a Miniature Boom-Microphone Headset Combination

It is the smallest such device in the world . . . . 2/3 oz.
It has flown the fastest . . . . 17 560 mph. (see below*)
It has flown the highest . . . . 176 mi. (see below*)
It is the MOST in sophisticated communications devices in the world for the money

MS-20/T-30 . . . . $38.50 Microphone only
MS-30/T-30 . . . . $67.00 Microphone & Receiver
Ready to plug in — no installation costs!

Price includes:

- 1 oz. headband for optional wearing
- Quick attaching control wheel mounted PUSH-TO-TALK switch (pre-wired)

*A Development of:

- Pacific Plantronics MS-41 (standard in the Project MA-8 Mercury Astronauts' space suits)
- Pacific Plantronics MS-50 (Soon to be standard on United Air Lines jet fleet)

Dealer Inquiries Invited

(Pat. appl. for)

PACIFIC PLANTRONICS, INC.
P. O. Box 604 • Santa Cruz, Calif. • GA 6-5858

Voice Engineered Freq. Response:

Nominal 280 — 4200 cps ± 6 db

- 3,000 Ω impedence, microphone
  600 Ω impedence, receiver
- 49 dbm at normal speech level

Model MS-50 & MS-40 (FAA TSO, C-57 & C-58)
Available at substantially higher prices on request

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Gentlemen: Please send me Air Mail prepaid

_____ MS-30/T-30 Headsets . . . . @ $67.00
_____ MS-20/T-30 Microphones . . . . @ $38.50

I am enclosing my check for ____________ in payment
(please add 4% sales tax to California orders).
Specify aircraft type ____________

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HEADSET-MICROPHONE
PACII . PLANTRONICS

BW

New producɩs briefs

New type headset weighs only 2 oz., but offers clearer voice communication

If orbiting astronaut Walter M. Schirra, Jr., sounded clearer than his predecessors over radio and TV, it was probably because he wore a small, new type of headset such as the one in the picture. Produced by Pacific Plantronics, Inc., of Santa Cruz, Calif., the MS-50 unit has two big selling points for space applications—sound clarity and a total weight of only 2 oz.

Keith Larkin, PPI president, says the MS-50 has broad industrial applications. For example, the company developed the unit because United Air Lines wanted a smaller headset for jet pilots. The airline now uses it throughout its jet fleet.

The key to the MS-50's clarity and light weight is what PPI calls an Acoustical Transfer Tube. A solid-state microphone-receiver clips to frames of glasses or to a lightweight headband. Sound waves enter the receiver or go to an ear plug through the specially engineered plastic tube that acts much like a wave guide on a radar set. This construction eliminates the explosive, static-causing qualities of "s" and "th" sounds, making the speaker's words sharper and more distinct.

Sets come with a variety of cords and plugs—depending on the user's needs—and can be equipped with built-in amplifiers if desired. Costs vary according to the combination required, but the basic headset sells for $35, with the quantity price dropping below $30.

Tough bonding for metals and plastics has thickness of a single molecule

An adhesive with the thickness of a single molecule is the key to a new method of bonding metals to thermoplastics, developed by Bell Telephone Laboratories. Such a bond between aluminum and polyethylene will resist more tearing and pulling than the plastic itself; previous bonds couldn't withstand heavy mechanical stress at high humidities and temperatures.

Many electronic applications are expected. A permanent bond between polyethylene insulators and copper conductors could improve the mechanical properties of telephone cables, and make printed circuits more reliable.

The trick is a single layer of stearic acid—a long-chain hydrocarbon—that is floated onto the metal. The acid end of the molecule combines with the aluminum as aluminum stearate. The hydrocarbon end tends to "stand up," and will dissolve on contact in molten polyethylene, which is also a hydrocarbon. The method is said to bond aluminum, stainless steel, and copper to such plastics as polypropylene and polystyrene by using other hydrocarbon acids.

GE offers tantalum foil capacitors that are claimed to be leakproof

General Electric Co. has introduced a new line of tantalum foil capacitors that are, it says, practically leakproof, thus more reliable for space uses and other critical electronic applications.

Tantalum foil capacitors have been widely used because, for their size, they handle higher voltage, have more capacitance, and have better self-healing characteristics than other capacitors. But they leak small amounts of contained electrolytic solutions, resulting in capacitance drop and vapor leakage. Tantalum oxide building up eventually forces an opening between the wire lead and the glass that seals the capacitor.

Key to the new device is a chemical seal between the lead-out wire and the glass plug through which the wire passes, plus a new type of glass that is chemically stable with the electrolyte. Developed under a Minuteman missile contract, this method has enabled GE to make what it dubs a "true hermetic seal" for tantalum foil capacitors. Prices range from about $10 to $20 a thousand, depending on capacitance.

■ ■ ■

Goodyear Aircraft Corp. has announced a computer memory system that, it claims, can simultaneously compare up to 32,000 10-digit numbers. Goodyear says this associative or "tag" memory system should be up to 100 times as fast as conventional computer searching methods, which must examine each entry on a word-by-word basis. Main use of the memory—which can be used in tandem with existing computer systems or incorporated into advanced computers—would be high-speed sorting, as in cryptographic analysis.

Airtemp Div. of Chrysler Corp. has halved the size of chillers for air-conditioning applications of 20 to 100 hp. and claims to have made them vibration-free in operation. Airtemp also says they are the first chillers in this size range to have completely enclosed cabinets.

Radio Corp. of America has announced an experimental electron tube that may open communication and radar channels near the frequencies of infrared light, in the so-called millimeter-wave region of the microwave spectrum. The tube uses the interaction of a pulsating electron beam and ionized cesium gas, or plasma, to amplify radio signals that oscillate up to 23-billion times a second. This would give the beam a capacity at least 50 times as great as that of standard television signals.

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Wall Street Journal
Sept. 6, 1963
Page 16

Thank You...

BELL TELEPHONE SYSTEM

...for contributing to the growth, within two short years, of a two-man company with an idea, to an industrial-aerospace manufacturer with forty employees ...AND STILL GROWING, through your acceptance* of our product, the Plantronics Switchboard Headset.

* Initially being delivered in quantity to Pacific Telephone & Telegraph Company only, one of 22 Bell operating companies.

FROM THE MANAGEMENT AND STOCKHOLDERS OF

PACIFIC PLANTRONICS, INC.

Santa Cruz, California

Cash Prices

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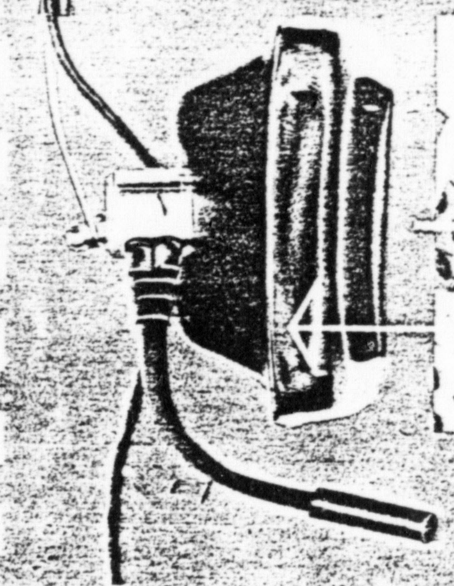
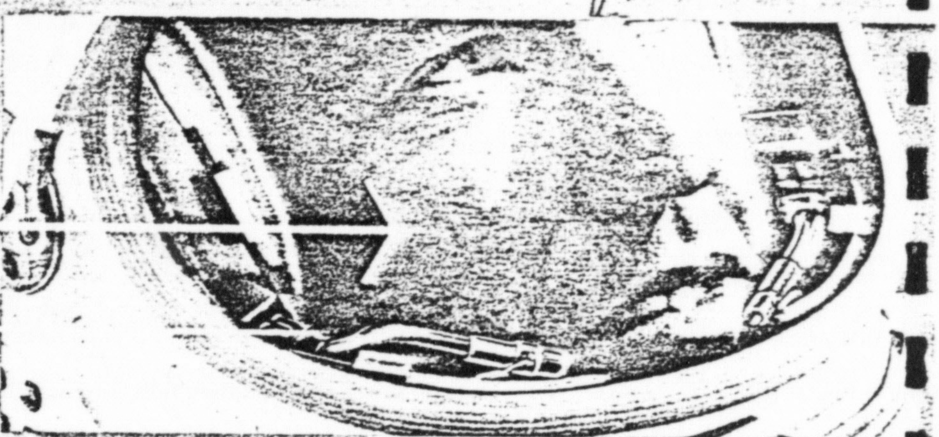
P.I. File
PLANTRONICS HEADSET

1

Ultra-Light Weight
MICROPHONE-RECEIVER HEADSET

Earmuff Configuration





Mercury Astronaut Gordon Cooper wearing a Pacific Plantronics Acoustical Tube Microphone-Receiver during his epic 22-orbit flight in May 1963

Compact, Comfortable, Eliminates Boom Microphone

Proven by Rigid Testing in Space, Ground Control and Industrial Applications

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PACIFIC PLANTRONICS, INC.

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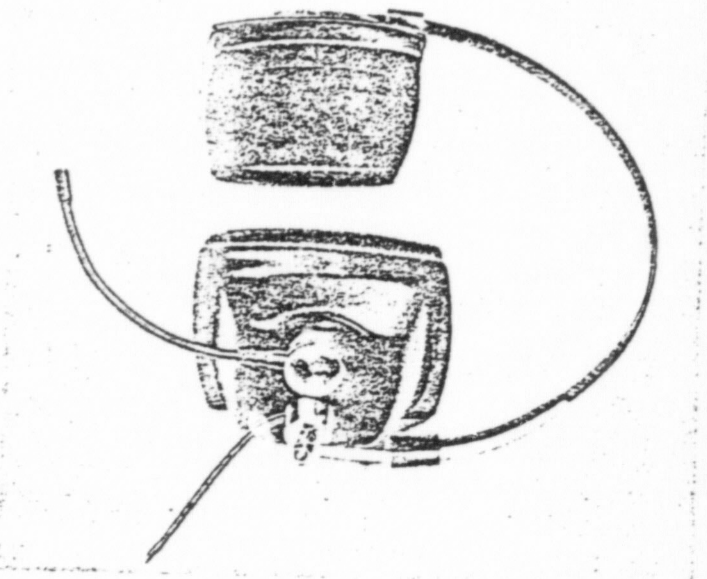
A NEW DIMENSION IN COMMUNICATIONS



Pacific Plantronics introduces the first light weight, comfortable earmuff configuration headset. The unit is highly efficient in reducing noise and sibilants. The new headset is available in a variety of configurations, which are described in this brochure, permitting low-cost custom adaptation to a broad range of operating systems and environments. The new Pacific Plantronics design is the first headset to be human-engineered to fit rather than pinch the ear, the first to eliminate the troublesome boom-type microphone, the first light weight unit to offer effective noise suppression without lip contact, and the first to permit continuous wearing with a variety of headgear.

MS-55 STANDARD HEADSET

This headset is available with one or two noise-suppressing muff receivers and a standard (non-noise cancelling, straight pressure sensitive) microphone. This microphone, far less cumbersome and far more reliable than the usual boom microphone, consists of a shock-resistant dynamic transducer mounted on the outer surface of one earmuff, and a tuned acoustical tube which is supported at an angle from the microphone transducer housing, to position the tube end at one side of the wearer's mouth. This tube is acoustically designed to conduct proper word sounds to the microphone transducer, but avoids hissing sibilants due to its placement at the side of the mouth. The microphone output, available at the jack-terminated connecting cord, can be used directly for dynamic-drive circuits, or with one of the amplifiers shown on the opposite page for carbon-mike circuits.

The Model MS-55 is available in the following configurations:

- MS-55-1 One earmuff receiver, with perforated earcup on other side of headband to provide support and admit sound.
- MS-55-2 Two earmuff receivers, providing receiver sound to each ear (as illustrated).
- MS-55-3 Two earmuffs, one with no receiver, to provide full background noise suppression.
- MS-55-4 Two earmuff receivers, with a separate receiving circuit connected to each for monitoring two channels simultaneously.

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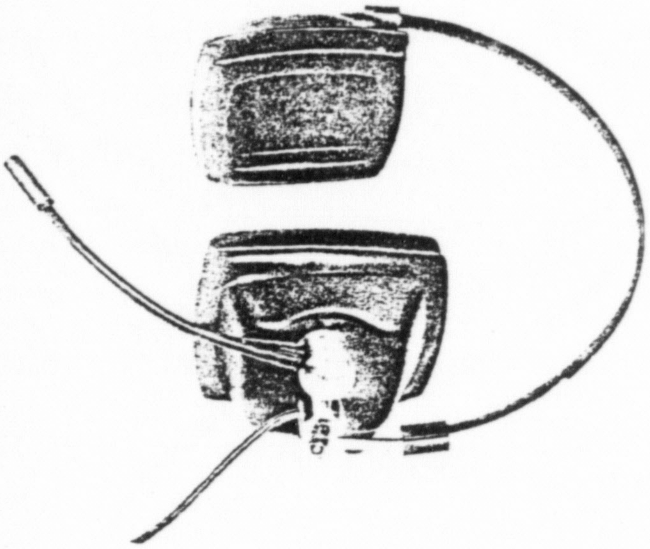
Human-Engineered
Acoustically Engineered
Electronically Engineered



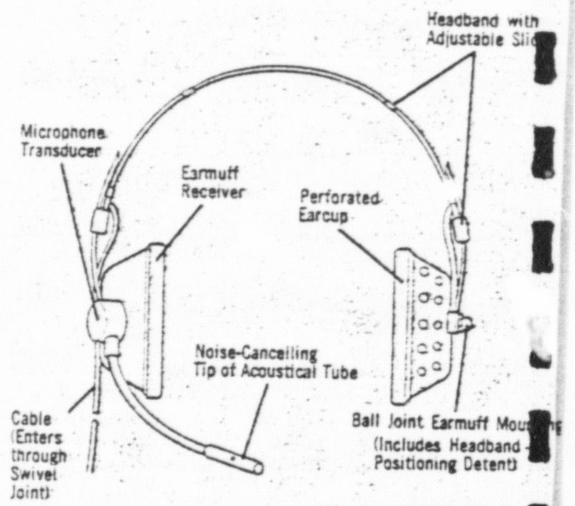
MS-56 WITH NOISE-CANCELLING MICROPHONE

This headset is available with one or two noise-suppressing muff receivers and a special noise-cancelling microphone. The microphone, similar in appearance to the MS-55, employs dual acoustical tubes wrapped in a single sheath, and a dual transducer. The dual acoustical tubes terminate in a special noise suppression tip. Spoken sounds from the mouth enter perforations at one end of the tip, and are fed to only one of the two tubes. Background noise enters the tip both at the end near the mouth and the other end, and each end feeds the noise to a different tube. The tube terminations are arranged within the tip to provide equal acoustical length. Thus, one tube conducts both sound and noise to the dual transducer, while the other conducts only noise, in-phase with the noise in the first tube. The transducers are connected in phase opposition to provide common-mode rejection of the noise while clearly transducing the sound. As shown in the graph on the rear cover, at least 20 db noise rejection is obtained within the flat portion of the response curve.

The Model MS-56 is available in the same configurations as listed above for the MS-55. The same dash numbers are used to denote the configuration.

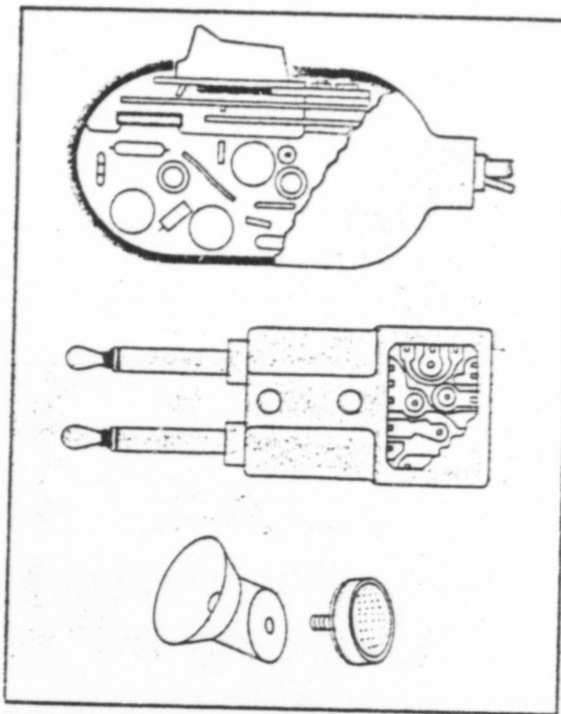
The new Pacific Plantronics design is the fi "totally-engineered" headset. The earmuff dimensions were established by a human engineering study of ear sizes, resulting in the unique square shape that for an acoustical chamber around the ear, fitting snug against the head. This chamber provides more than 20 db positive suppression of background noise completely insulating the ear. The earmuffs contain Mil Spec receiver element and are attached to the headband with an adjustable positioning slide. The one-piece spring steel headband provides snug b light tension and avoids bending and breakage pro lems of multiple-piece headbands. The earmuffs are ball joint mounted to the headband to allow tilting for an exact fit to any ear, and to allow the headba to be tilted to the neckline for wearing with a ha hat. The strain relief which attaches the ball joint to the earmuff and serves as the cable entrance fitti can be rotated to place the acoustical tube in prop position for left-side or right-side wearing. The ea muff ball joints have a detent which will secure the headband in the vertical position.

The microphone transducer is sealed inside spring-loaded, ball joint mounted earmuff. The special encapsulated mounting is shock-proof to 10,000 instantaneous G's and more than 100 sustained G The acoustical tube is sized and shaped for optimu speech pickup.



MS—56 HEADSET COMPON

(2 4



A Broad Range of Amplifiers and Accessory Adapters is Available for Optimum Adaptation to Any Situation

A Range of Microphone Impedances for Dynamic Applications

The special Pacific Plantronics microphone transducer is a direct electrical replacement for dynamic microphones, and can be plugged into circuits where non-carbon microphones are presently used. A small switch module designed for attachment to the wearer's belt is used to connect the headset cord plug to the coiled cord which attaches to the communications equipment. This belt-clipped push-to-talk switch is available either locking or non-locking. The headset cord and coiled cord are captive to the switch module. Coiled cord length and plug style options are listed on the rear of this brochure. Available microphone impedances are 3000 ohms, 150 ohms, and 5 ohms.

A Variety of Solid-State Amplifiers for Use in Carbon-Microphone Circuits

These compact, highly efficient solid-state amplifiers bring all the fidelity and environmental advantages of precision dynamic microphone instruments to carbon microphone circuitry. Three popular amplifier models are described below. Others are available on special order.

- *Model T-51 and T-52 Intercommunications Amplifiers*

These amplifiers are contained in the belt-clipped switch modules, and are powered by the communications equipment carbon-microphone input circuitry. They increase the dynamic microphone signal level to the level of a carbon microphone. Currents of 30 ma and 120 ma can be carried in these amplifiers with voltage outputs of up to 1 V rms. Each module has a push-to-talk switch, with optional locking or non-locking feature. Each amplifier is non-polarized. The T-51 is for four-wire circuits, with the switch in series with the talking circuit. The T-52 is for six-wire circuits, with the switch controlling a separate relay-activating circuit. The headset cord and coiled cord are captive to the amplifier-switch module. Coiled cord length and plug style options are listed on the rear of this brochure.

- *Model T-54 Switchboard and PBX Amplifier*

This amplifier is contained in a dual two-circuit plug which attaches directly to the switchboard and operates from the conventional switchboard excitation circuit designed to power carbon microphones. The T-[illegible] is also unpolarized and will handle the same a[illegible] power as the T-51 and T-52. No coiled cord or switch module is required since the T-54 is inserted in the switchboard.

Adapters Permit Use With Masks for Smoke or Hostile Environments

The Pacific Plantronics headset is the only one designed for *both* normal applications and face-mask use in hostile environments. The same headset can be worn continuously, requiring only a small adapter fitted to the mask, and eliminating the costly requirement of a separate mask microphone. To preserve the isolated environment inside a face mask while continuing to wear the same earmuff headset with the out-of-the-way acoustical tube microphone, a simple PMM-1 quick-connect adapter is available for permanent installation in the mask. The mouth end of the headset acoustical tube then plugs into a hole in the outer surface of this adapter. This all-stainless steel adapter has a diaphragm which transmits spoken sounds while providing an airtight seal. The adapter is designed with special acoustical characteristics to compensate for the low-frequency resonant effects of the mask face chamber and provide the same clear spoken output that the acoustical tube makes possible when the mask is not worn. A PMM-2 adapter is available for use at altitudes above 35,000 feet. Any of the headset amplifiers described above is available in an explosion-proof configuration with a sealed push-to-talk switch.

Low-Impedance and High-Impedance Receiver Elements are Available

Either of two Mil Spec receiver elements can be supplied in the earmuffs. Connections to the receiver and microphone transducer are made through a small terminal strip inside the earmuff and accessible by slipping off the muff shell for ease of maintenance. The 19-ohm low impedance receiver meets specification MIL-H-143/A1C, and the 300-ohm high impedance receiver meets specification MIL-H-11134.

764 10d

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ORDER THE BEST IN HEADSETS . . .
DIRECTLY FROM PACIFIC PLANTRONICS

- Ultra-Light Weight
- Out-of-the-way Acoustical Tube Replaces Bulky Mouthpiece
- Easily Adapts to Smoke Masks
- Comfortable to Wear
- Improved Microphone Response Plus Optional Noise-Cancelling
- No Interference with Hard Hat

FOR AEROSPACE APPLICATIONS — A VERSATILE HEADSET FOR CONSTANT WEARING

FOR TEST COMPLEX APPLICATIONS

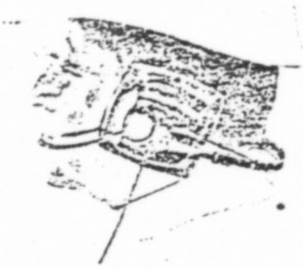
The Pacific Plantronics headset is designed as a real system communications component for constant wearing. The headset weight, which ranges from 6 to 8 ounces, is half that of conventional headsets, and the newly designed earmuff provides an honest 20 db-noise insulation compared to conventional earpiece receivers. In addition, the alternate headset configuration with noise cancellation provides an optional plus fa tor of 20 db. In addition to its functional advantages, this new headset is designed for durability and ease of maintenance. It offers proven reliability and reduced maintenance costs. The design simplicity means that there is virtually nothing to break. Instead of a troublesome boom microphone and a fragile multi-piece headband, this "space age" design offers an encapsulated, shock-resistant microphone transducer with a flexible, unbreakable spring steel headband, and all joints are break-resistant ball or swivel type. Parts replacement can be accomplished without soldering thanks to the special screw-type terminal strip placed within the earmuff for connections. Pluck-out or screw-retained part mountings are used for all parts to allow quick replacement with common hand tools.

FOR HARD HAT AREAS

In control complexes the earmuff headset can be worn continuously whether or not a hard hat is required. The only headset to permit use with a hard hat without altering the hard hat webbing, the Pacific Plantronics headset has no interface with the hard hat at all. With the headband lowered to the horizontal position, the head is completely unencumbered, allowing the hard hat to be worn normally and changed instantly. The near-weightlessness and special earmuff design of the headset keeps it properly positioned with the headband in the horizontal position, and the earmuffs provide a welcome background noise reduction of 20 db or more.

FOR USE WITH GAS AND SMOKE MASKS

No longer must the headset be changed when donning a mask. Due to its versatile design the Pacific Plantronics headset can be worn continuously while working in or out of hostile environments. The mask can be permanently fitted with a tiny, non-electrical, stainless steel acoustical mouthpiece. The acoustical tube connects to the exterior of this mouthpiece, to carry sounds to the headset microphone transducer in the normal manner. Thus, the wearer just plugs his normal mouthpiece tube into the adapter when donning the mask.



IDE

Standard Cord Lengths for Ranges Up To 25 Feet

Three standard extended cord lengths are available up to 25 feet. These are quality, rugged cords with tough vinyl jackets, and retract to 1/3 their length when not in use. The design of rugged cords with straight ends and flexible coiled centers makes it impossible to supply custom lengths without extra cost. Standard lengths which cover a complete range of sizes are listed below:

Standard Cord Length (Stretched)	Covers Length Range
10 feet	6 to 10 feet
15 feet	11 to 15 feet
24 feet	16 to 25 feet

A BROAD RANGE OF PLUG STYLES IS AVAILABLE

	Standard Plugs								Other Typical Plugs		
	[illegible]	PJ-055B (2 circuit panel plug)	3 Conductor phone plug	[illegible]	PJ-327		WE 3??? type		[illegible]	[illegible]	[illegible]
	CONNECTIONS										
Contact					LH	RH	LH	RH			
Tip 1 or A	Switch	Rcvr Hi	Mic Hi	Mic Lo	Ampl	Ampl	Ampl	Ampl	Mic Hi (+)	L Rcvr Hi	L Rcvr Hi
1st Ring 2 or B	Ampl (+)		Rcvr Hi	Rcvr Hi			Switch	Switch	Mic Lo	L Rcvr Lo	L Rcvr Lo
2nd Ring 3 or C				Mic Hi					Rcvr Hi	C Tied to J	C Tied to J
Sleeve 4 or D	Switch Ampl Com	Rcvr Lo	Rcvr Lo Mic Lo	Rcvr Lo	Rcvr	Rcvr	Rcvr	Rcvr	Rcvr Lo	Rt Rcvr Hi	Rt Rcvr Hi
5 or E										Ampl Lo	Ampl Lo
6 or F										Ampl Hi (+)	Ampl Hi (+)
7 or H										Rt Rcvr Lo	Rt Rcvr Lo

CONDENSED SPECIFICATIONS

Acoustical Tube Microphone Transducer

Frequency Response:	Voice engineered 280 cps to 4000 cps (±6 db)
Output Level:	−49 dbm for typical speech referenced to 3K ohms (105 db SPL re .0002 dyne/cm.²)
Standard Impedances:	3000 ohms, 150 ohms, and 5 ohms @ 1 KC

Receiver

Frequency Response:	300 cps to 3000 cps (± 5db)
Impedance:	19 ohms and 300 ohms @ 1 KC
Signal Level:	Up to −2 dbm

T-51/T-52/T-54 Amplifier

Current Range:	30 MA to 120 MA
Output Impedance:	Less than 100 ohms
Output Level:	Equivalent to telephone type carbon microphones; linear to 1 volt RMS

ORDERING INFORMATION

Because of the many configurations possible, made up from the "building blocks" described in this brochure plus other special adaptations, Pacific Plantronics prefers orders to be placed by specifying each of the applicable items from the list below. Prices are available on request. A special Pacific Plantronics part number will be assigned for each customer-specified headset configuration to permit subsequent ordering by part number.

To order, submit a simplified schematic of the plug—microphone—earmuff connections desired, and specify:

a. Type of headset desired by number (see inside pages: e.g. MS-56-2).

b. Plug type (see chart above)

c. Plug wiring (simplified schematic)

d. Type of cord required and length (see list above)

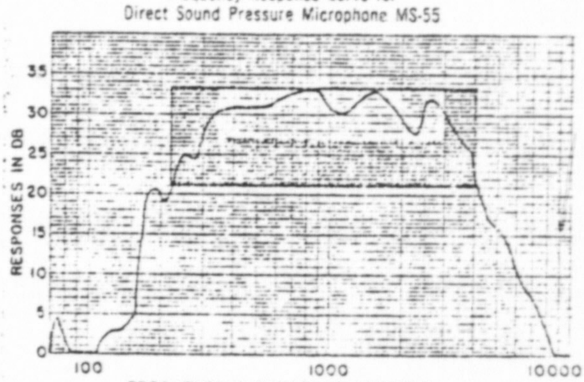
e. Locking or non-locking push-to-talk button

f. Whether face mask adapter is desired (describe face mask application in detail)

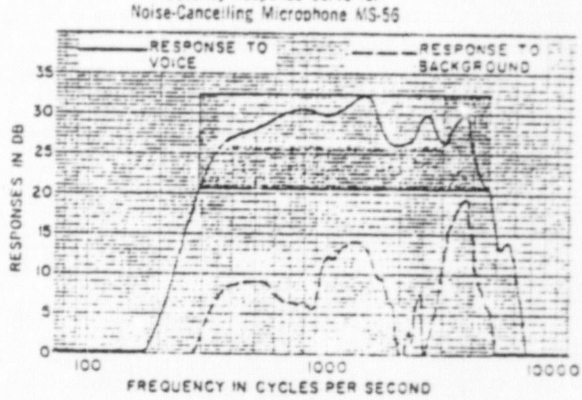
g. Type of communications system and operating data (e.g. if carbon type microphone excitation, give excitation current available and number of headsets to be paralleled at one time; if non-carbon type, give input impedance and signal level; also give receiver line impedance and operating level)

h. Describe any special requirements such as foot-switch control circuitry, explosion-proof switches, etc.

Frequency Response Curve for Direct Sound Pressure Microphone MS-55



Frequency Response Curve for Noise-Cancelling Microphone MS-56



Microphone Response: The dark shaded area on the graphs indicates the ±6 db response range provided by each microphone, and the lighter shading indicates the minimal frequency response required by government specifications. Microphones are tested under "free field" conditions and provide less than 10% distortion with sound pressure levels up to 120 db.

Receiver Response: The receiver response is not shown, but is essentially the same as the microphones, except that low frequency response is typically lower than 100 cps.

PACIFIC PLANTRONICS, INC.

P.O. Box 604 · Santa Cruz, Calif. · GA 6-5858 · Area Code 408

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PAC-1 acoustic coupler for background noise reduction

application This new, noise-reducing accessory is now available for Pacific Plantronics Headsets. Specifically designed for use in places where background noise hinders voice transmission, it is ideal for use in such areas as open offices and factories.

clarity The PAC-1 Coupler provides 10 db noise reduction — without affecting voice transmission clarity.

comfort & convenience The small size of the PAC-1 Acoustic Coupler makes it inconspicuous when attached — and its extreme light weight (1/20 ounce) allows it to be worn unnoticed. Couplers are easily installed and removed — using light finger pressure only.

aerospace durability Designed to complement the aerospace durability of PPI headsets, the rugged construction of the PAC-1 Coupler keeps it operating efficiently even under the roughest handling. The Coupler is also rain resistant making it highly effective for outdoor applications.

characteristics The unique cup-shape of the Coupler captures voice sounds, thereby increasing voice volume at the microphone. Sintered acoustical resistance in the Coupler then reduces both voice and background noise. The effect is cleaner voice transmission with ambient noise greatly reduced. When used in conjunction with public address systems, 14 db protection against feedback is obtained.

installation Using light finger pressure, the PAC-1 Coupler is slipped on the end of the Headset Acoustical Transfer Tube. The Coupler is then easily swiveled directly in front of the operator's mouth.

PACIFIC PLANTRONICS, INC.
111 Josephine St., Santa Cruz, California
SUPPLIERS OF ASTRONAUT HEADSETS TO PROJECTS GEMINI AND APOLLO

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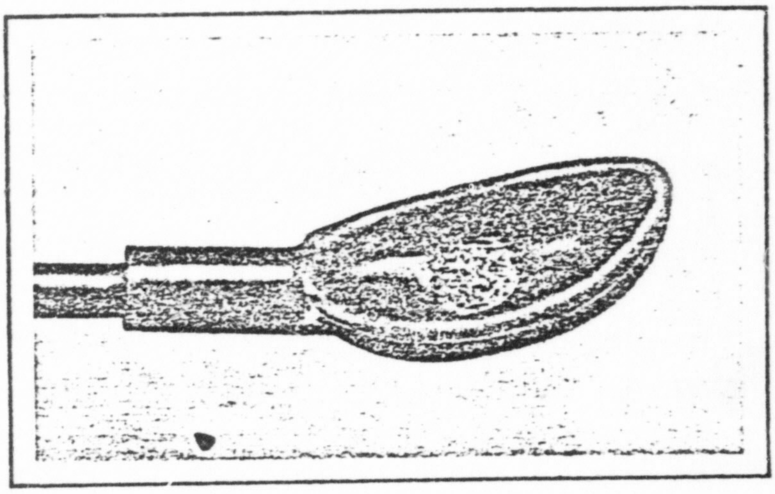
PAC-1



maintenance

Simple design and rugged construction limits maintenance to occasional cleaning. The Coupler is easily cleaned by washing it in common cleaning solvent and blowing air through it to dry.

specifications

Color . . . . Black

Average Noise Reduction . . . . 10 db

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Technical Data

RECEIVER

The receiver is completely enclosed in a

ANSI
S1.1-1960(R1971)
Revision of
Z24.1-1951
and including
Z24.1a

USA standard

S1.1-1971(R-1960)

Acoustical Terminology

(Including Mechanical Shock and Vibration)

Sponsor

Acoustical Society of America

American National Standard

This standard is one of more than 4000 approved as either a USA Standard or as an American Standard. It became an American National Standard in October 1969 when the Institute changed its name to American National Standards Institute, Inc.

ANSI, 1430 Broadway, New York, N.Y. 10018

Approved May 25, 1960

Ex. E

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DEFENDANT'S EXHIBIT

NO. E

USA Standard

A USA Standard implies a consensus of those substantially concerned with its scope and provisions. A USA Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of a USA Standard does not in any respect preclude anyone, whether he has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. USA Standards are subject to periodic review and users are cautioned to obtain the latest editions. Producers of goods made in conformity with a USA Standard are encouraged to state on their own responsibility in advertising, promotion material, or on tags or labels, that the goods are produced in conformity with particular USA Standards.

This USA Standard is one of nearly 3000 standards approved as American Standards by the American Standards Association. On August 24, 1966, the ASA was reconstituted as the United States of America Standards Institute. Standards approved as American Standards are now designated USA Standards. There is no change in their index identification or technical content.

Published by

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770

Two exchange lines and up to six This switchboard unit, designed to

Foreword

[This Foreword is not a part of American Standard† Acoustical Terminology (Including Mechanical Shock and Vibration), S1.1-1960.]

Under the procedure of the American Standards Association, in response to a request from and under the sponsorship of the Acoustical Society of America, a sectional committee was organized in May 1932 to prepare standards on terminology, units, scales, and methods of measurement in the field of acoustics. Four subcommittees were appointed, including one on acoustical terminology. Work of that subcommittee and its subcommittee on musical acoustics, following a pattern established by an earlier committee on acoustical standardization appointed by the Acoustical Society of America, led ultimately to American Tentative Standard Acoustical Terminology, Z24.1-1936. This was followed by a revision, American Standard Acoustical Terminology, Z24.1-1942. Immediately thereafter, in May 1942, the scope of the work was explicitly expanded to include mechanical vibration.

Following World War II, with its impact on acoustical work, both the Acoustical Society of America, as sponsor of American Standards Association Sectional Committee Z24, and the Institute of Radio Engineers* recognized the need for revision of standards on acoustical and electroacoustical terminology. The American Institute of Electrical Engineers,* as sponsor of Sectional Committee C42, also undertook a revision of American Standard Definitions of Electrical Terms. After several years of independent effort, the ASA and IRE committees were combined; this larger group worked in close cooperation with various subcommittees of C42 concerned with the definitions of electrical terms, and the result was American Standard Acoustical Terminology, Z24.1-1951. Shortly thereafter work was started on terminology particularly concerned with vibrations of structures, and this led to publication for trial and criticism, in February 1955, of a supplement to Z24.1-1951 entitled Proposed American Standard Shock and Vibration Terminology.

The present revision was started in 1953 as part of the work of Sectional Committee Z24. With the organization of the Acoustical Standards Board and the creation of Sectional Committees S1, S2, and S3, the work was continued under all three committees, Committee S1 having primary responsibility. The number of the standard was accordingly changed from Z24.1 to S1.1. The memberships of these three committees at the time of approval were:

Sponsors
- S1: Acoustical Society of America
- S2: Acoustical Society of America
  American Society of Mechanical Engineers
- S3: Acoustical Society of America

	S1	*S2*	*S3*
Chairman:	A. P. G. Peterson	H. M. Trent	W. D. Neff
Vice-Chairman:	J. R. Cox, Jr	C. E. Crede	H. E. Von Gierke
Secretary:	S. David Hoffman	S. David Hoffman	S. David Hoffman

Organization Represented	*Names of Representatives* S1	S2	S3
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Acoustical Society of America	J. R. Cox, Jr A. P. G. Peterson	H. M. Trent I. Vigness	W. D. Neff H. E. Von Gierke
Air Conditioning and Refrigeration Institute	J. R. Chamberlain F. J. Reed (*Alt*)		
Air Moving and Conditioning Association, Inc	R. E. Parker (*Alt*)		
American-British-Canadian Navy Tripartite Standardization		C. B. Irwin W. A. Murauskas (*Alt*)	
American Academy of Ophthalmology and Otolaryngology			E. P. Fowler, Jr
American Conference of Governmental Industrial Hygienists			C. D. Yaffe
American Industrial Hygiene Assn			P. L. Michael
American Institute of Electrical Engineers	C. G. Veinott R. H. Lee, Sr (*Alt*) C. H. Smith (*Alt*)	C. A. Arents	E. G. Thurston
American Otological Society, Inc			G. D. Hoople

*Now IEEE (Institute of Electrical and Electronics Engineers).

†All American Standards are now designated USA Standards.

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Facilities

General information

Two exchange lines and up to six This switchboard unit, designed to

Organization Represented	*Names of Representatives*		
	S1	*S*	*S3*
American Society of Heating and Air Conditioning Engineers	R. D. Madison		
American Society of Mechanical Engineers		C. E. Crede D. C. Kennard H. S. Bean (*Alt*)	
American Society of Refrigerating Engineers	S. Soling		
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Acoustical Units

Phillippe E. le Corbeiller, *Chairman*

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Contents

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USA Standard
Acoustical Terminology
(Including Mechanical Shock and Vibration)

1. General

1.1 Sound

(1) Sound is an oscillation in pressure, stress, particle displacement, particle velocity, etc, in a medium with internal forces (e.g., elastic, viscous), or the superposition of such propagated oscillations.

(2) Sound is an auditory sensation evoked by the oscillation described above.

NOTE 1: In case of possible confusion, the term "sound wave" or "elastic wave" may be used for concept (1) and the term "sound sensation" for concept (2). Not all sound waves can evoke an auditory sensation; e.g., ultrasound.

NOTE 2: The medium in which the sound exists is often indicated by an appropriate adjective; e.g., air-borne, water-borne, structure-borne.

1.2 Acoustics

(1) Acoustics is the science of sound, including its production, transmission, and effects.

(2) The acoustics of a room are those qualities that together determine its character with respect to distinct hearing.

1.3 Acoustic, Acoustical. The qualifying adjectives "acoustic" and "acoustical" mean containing, producing, arising from, actuated by, related to, or associated with sound. *Acoustic* is used when the term being qualified designates something that has the properties, dimensions, or physical characteristics associated with sound waves; *acoustical* is used when the term being qualified does not designate explicitly something that has such properties, dimensions, or physical characteristics.

NOTE 1: The following examples qualify as having the "properties or physical characteristics associated with sound waves" and hence would take *acoustic*: impedance, inertance, load (radiation field), output (sound power), energy, wave, medium, signal, conduit, absorptivity, transducer.

NOTE 2: The following examples do not have the requisite physical characteristics and therefore take *acoustical*: society, method, engineer, school, glossary, symbol, problem, measurement, point of view, end-use, device.

NOTE 3: As illustrated in the preceding notes, usually the generic term is modified by *acoustical*, whereas the specific technical implication calls for *acoustic*.

1.4 Oscillation. Oscillation is the variation, usually with time, of the magnitude of a quantity with respect to a specified reference when the magnitude is alternately greater and smaller than the reference.

1.5 Vibration. Vibration is an oscillation wherein the quantity is a parameter that defines the motion of a mechanical system.

1.6 Periodic Quantity. A periodic quantity is an oscillating quantity whose values recur for certain increments of the independent variable.

NOTE 1: If a periodic quantity v is a function of t, then

$$v = f(t) = f(t + T)$$

where T, a constant, is a period of v.

NOTE 2: In general, a periodic function can be expanded into a series of the form

$$y = f(t) = A_0 + A_1 \sin(\omega t + a_1) + A_2 \sin(2\omega t + a_2) + \cdots,$$

where

ω, a positive constant, equals 2π divided by the period T, and the A's and a's are constants which may be positive, negative, or zero.

1.7 Primitive Period (Period). The primitive period of a periodic quantity is the smallest increment of the independent variable for which the function repeats itself.

NOTE: If no ambiguity is likely, the primitive period is simply called the period of the function.

1.8 Cycle. A cycle is the complete sequence of values of a periodic quantity that occur during a period.

1.9 Frequency. The frequency of a function periodic in time is the reciprocal of the primitive period. The unit is the cycle per unit time and must be specified.

NOTE: In many European countries the cycle per second is called the hertz (Hz).

1.10 Angular Frequency (Circular Frequency). The angular frequency of a periodic quantity, in radians per unit time, is the frequency multiplied by 2π. The usual symbol is ω.

1.11 Basic Frequency. The basic frequency of an oscillatory quantity having sinusoidal components with different frequencies is the frequency of the component considered to be the most important.

NOTE: In a driven system, the basic frequency would in general be the driving frequency, and in a periodic oscillatory system, it would be the fundamental frequency.

1.12 Audio Frequency. An audio frequency is any frequency corresponding to a normally audible sound wave.

NOTE 1: Audio frequencies range roughly from 15 to 20,000 cycles per second.

NOTE 2: The word "audio" may be used as a modifier to indicate a device or system intended to operate at audio frequencies, e.g., "audio amplifier."

1.13 Ultrasonic Frequency. An ultrasonic frequency is a frequency lying above the audio fre-

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6.67 Direct Radiator Loudspeaker. A direct radiator loudspeaker is a loudspeaker whose radiating surface, or diaphragm, is in direct contact with the medium into which it radiates, without the interposition of any acoustic impedance-matching device.

6.68 Horn Loudspeaker. A horn loudspeaker is a loudspeaker whose diaphragm is coupled to the external acoustic medium by means of a horn used as an impedance-matching and directivity-controlling device.

6.69 Acoustic Horn (Horn). An acoustic horn is a tube of varying cross section having different terminal areas that provide a change of acoustic impedance and control of the directivity pattern.

6.70 Conical Horn. A conical horn is a horn whose cross-sectional area increases as the square of the axial length.

6.71 Exponential Horn. An exponential horn is a horn whose cross-sectional area increases exponentially with axial distance.

NOTE:
if
S = the area of a plane section normal to the axis of the horn at a distance x from the throat of the horn
S_0 = the area of the plane section normal to the axis of the horn at the throat
m = a contant which determines the rate of taper or flare of the horn
then

$$S = S_0 \epsilon^{mx}$$

6.72 Multicellular Horn. A multicellular horn is a cluster of horns with juxtaposed mouths that lie in a common surface. The purpose of the cluster is to control the directional pattern of the radiated energy.

6.73 Horn Mouth. The horn mouth is normally the end of a horn with the larger cross-sectional area.

6.74 Horn Throat. The horn throat is normally the end of a horn with the smaller cross-sectional area.

6.75 Acoustic Radiating Element. An acoustic radiating element is a vibrating surface in a transducer that can cause or be actuated by sound waves.

6.76 Baffle. A baffle is a shielding structure or partition used to increase the effective length of the external transmission path between two points in an acoustic system, as, for example, between the front and back of an electroacoustic transducer.

NOTE: In the case of a loudspeaker, a baffle is often used to increase the acoustic loading of the diaphragm.

6.77 Reflex Baffle. A reflex baffle is a loudspeaker baffle in which a portion of the radiation from the rear of the diaphragm is propagated forward after controlled shift of phase or other modification, the purpose being to increase the over-all radiation in some portion of the frequency spectrum.

6.78 Loudspeaker System. A loudspeaker system is a combination of one or more loudspeakers and all associated baffles, horns, and dividing networks arranged to work together as a coupling means between the driving electric circuit and the acoustic medium.

6.79 Dividing Network (Loudspeaker Dividing Network). A dividing network is a frequency selective network which divides the spectrum to be radiated into two or more parts.

6.80 Crossover Frequency. As applied to electric dividing networks, the crossover frequency is the frequency at which equal electric powers are delivered to each of the adjacent frequency channels when all channels are terminated in the loads specified.

6.81 Acoustic Interferometer. An acoustic interferometer is an instrument for measuring standing waves.

NOTE: It can be used to measure the properties of the medium or boundaries: for example, velocity, wavelength, absorption, impedance, propagation constant.

6.82 Acoustic Radiometer. An acoustic radiometer is an instrument for measuring acoustic radiation pressure by determining the unidirectional steady-state force resulting from reflection or absorption of a sound wave at a boundary.

6.83 Artificial Ear. An artificial ear is a device for the measurement of earphones that presents an acoustic impedance to the earphone equivalent to the impedance presented by the average human ear. It is equipped with a microphone for measurement of the sound pressures developed by the earphone.

6.84 Artificial Voice. An artificial voice is a small loudspeaker mounted in a shaped baffle that is proportioned to simulate the acoustical constants of the human head. The artificial voice is used for calibrating and testing close-talking microphones.

6.85 Bone-Conduction Vibrator. A bone-conduction vibrator is an electromechanical transducer intended to produce the sensation of hearing by vibrating the bones of the head.

6.86 Audiometer. An audiometer is an instrument for measuring hearing sensitivity.

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D/104
Ed. 2

Lightweight

HEAD TELEPHONE SETS AND HEAD RECEIVERS

Lightweight

Superior Performance

Unbreakable

Compact

Revolutionary Design

Ex. F

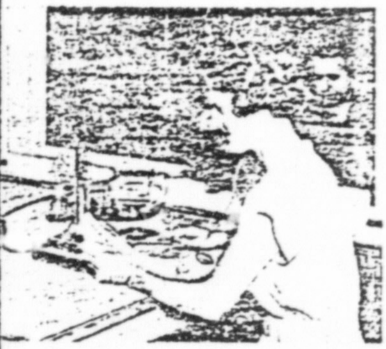
777

Standard Telephones and Cables Limited

1

1

2



3

4

LIGHTWEIGHT HEAD TELEPHONE SETS AND HEAD RECEIVERS

TYPES 4408, 4409, 4048, 4049

These lightweight head telephone sets and head receivers, developed by STC acoustic engineers, have attained a world-wide reputation. They are the latest type to be adopted for standard use by the British Post Office, and have been supplied to numerous administrations and other customers overseas for use in public and private telephone exchanges.

FEATURES

Extremely light weight.—An operator's telephone set with transmitter and two receivers weighs only six ounces.

Superior performance.—Both in transmission and reception, the quality and sensitivity are better than for any previous type of headset. The level of transmission is not affected by movement of the operator's head.

Remarkable strength.—Construction and materials employed reduce to a minimum the possibility of accidental breakage.

Unique, compact design.—Degree of comfort, stability and manoeuvre-ability surpass all previous types.

TYPES

Four versions of headset are available, having :—

(a) One transmitter and one receiver—Type 4408

(b) One transmitter and two receivers—Type 4409

(c) One receiver and no transmitter—Type 4048

(d) Two receivers and no transmitter—Type 4049

The photographs show the lightweight head telephone sets and receivers in use

PHOTO 1 *Overseas PABX installation*

PHOTO 2 *London Airport B.E.A. Control Centre*

PHOTO 3 *B.B.C. Studio London*

PHOTO 4 *Bournemouth Automatic Telephone Exchange*

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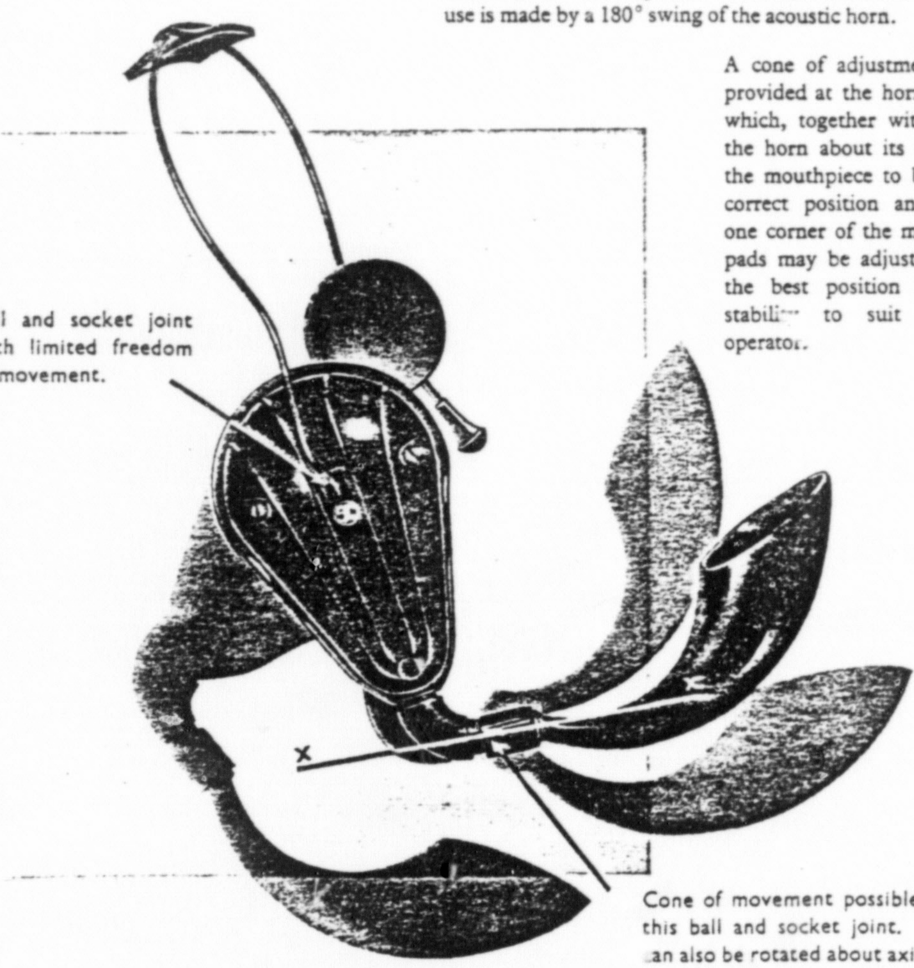
ADJUSTMENTS

The adjustments of the 4408 Telephone Set are as shown in the illustration below. The scope is limited to that necessary to accommodate the natural range of head variations, thus preventing the operator from degrading the transmission by excessive movements of the horn system. Provision for both right and left ear use is made by a 180° swing of the acoustic horn.

A cone of adjustment (max. 24°) is provided at the horn-elbow ball joint which, together with the rotation of the horn about its own axis, enables the mouthpiece to be brought to the correct position and angle opposite one corner of the mouth. The head-pads may be adjusted, by sliding, to the best position for comfort and stabili— to suit each individual operator.

Ball and socket joint with limited freedom of movement.



Cone of movement possible from this ball and socket joint. Horn can also be rotated about axis x—x

On the double headsets adjustment of the headband length can be made by sliding the headband wires in and out of the two side adaptors.

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3

STC

Standard Telephones and Cables Limited
Registered Office: Connaught House, 63 Aldwych, W.C.2.
TELEPHONE SWITCHING DIVISION
OAKLEIGH ROAD · NEW SOUTHGATE · LONDON · N.11
Telephone: Enterprise 1234 Telegrams: Essteecee, Telex, London

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...gust 1963

Printed in England by Metcalfe & Cooper Ltd

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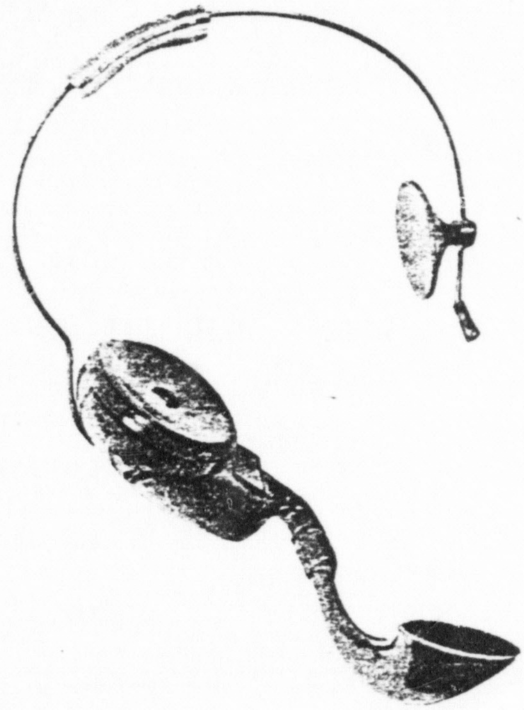
STC



LIGHTWEIGHT HEADSETS
Types 4408, 4409 4048, 4049

Application

These Lightweight Head Telephone Sets are the most up-to-date type adopted by European telephone administrations, for use in connection with manual switchboards, where the telephone operators have to handle a heavy traffic load with variable line conditions. By reason of their high quality of transmission and reception, the headsets are also most appropriate for use in office and factories where external noise may make it difficult for the telephone operators to work efficiently. The headset receivers are most suitable for monitoring where the operational conditions are difficult, such as at airports, control centres, etc.

The headsets with transmitters are primarily intended for 'Central Battery' use where the feed current is in the range of 20–50 mA. For feed currents in the higher range of 50–130 mA, special sets are used, which include an inductive shunt bridged across the transmitter terminals.

A 'Local Battery' version can be made available upon request.

Special Features

Both in transmission and reception, the quality and sensitivity are better than for any previous type of headset. The level of transmission is not affected by movement of the operator's head.

Nylon and other resilient plastic materials used in the manufacture, have contributed toward the instrument's small size and light weight. The headset is nevertheless remarkably strong because the form of construction and the materials employed reduce to a minimum the possibility of accidental breakage.

The headset may be worn on either ear. Its unique and compact design provide a degree of comfort, stability and manoeuvrability unsurpassed by previous types. There is a cone of free movement of the horn to allow for variations of head shape.

The horn can easily be removed for cleaning, and for hygienic reasons can even be immersed in disinfectant.

The independent fixing of transmitter and receiver facilitates maintenance, whilst the adjustable headpads ensure maximum wearing comfort.

Design Information

The main mouldings which encase the miniature transmitter and receiver capsules are of reinforced nylon material. The horn which is also of nylon, is connected by means of a ball and socket joint to the elbow leading to the transmitter housing and attached by a spring-loaded connection, which acts as a shock absorber.

The headband is formed of plastic-covered wire and fitted with adjustable flexible pads, providing a high degree of stability and comfort in wearing.

Four versions of headset are available as follows:—

a. Headset with one transmitter and one receiver—type 4408.
b. Headset with one transmitter and two receivers—type 4409.
c. Headset with one receiver and no transmitter—type 4048.
d. Headset with two receivers and no transmitter—type 4049.

All headsets are available in black, grey or ivory.

The recommended specially designed cordage combines lightness and flexibility with strength.

Most standard plugs, 2-, 4- or 6-way, are suitable for use with these headsets. Full details of existing plugs should be given when ordering, to ensure that suitable cord terminations are supplied.

Flexible earpads for cushioning the earpieces can be supplied on request.

A small but useful detail in the body moulding is a frame in which an identifying label may be fixed.

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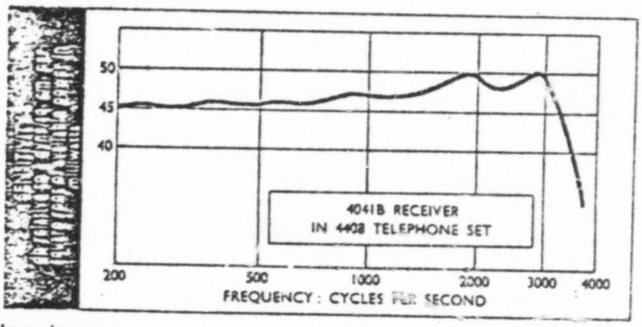
Technical Data

RECEIVER

The receiver is completely enclosed in a light capsule to protect the interior from damage and the ingress of dust and dirt.

Sensitivity:—
47 db relative to 1 dyne per square root of available power in milliwatts at 1000 c/s.



TYPE 4408

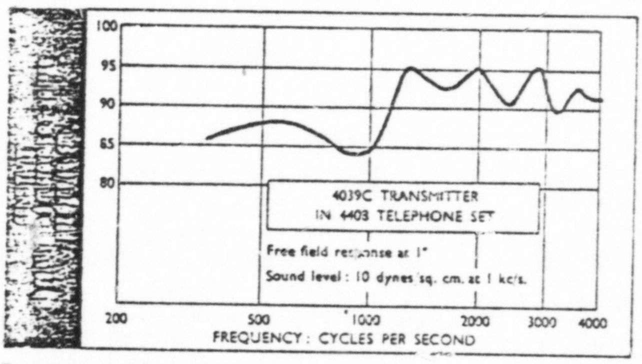
TYPE 4409

Impedance:—
Single receiver—150, 300, 600, 2400 or 4800 ohms at 1000 c/s. (Other values can be supplied on request.)

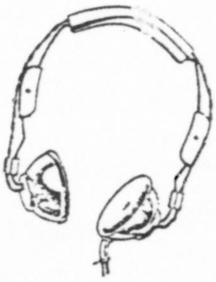
TRANSMITTER

The miniature carbon transmitter and horn system, together, have an overall frequency response and sensitivity similar to those of a modern high quality carbon transmitter. The efficiency of the horn rises with frequency, and this compensates for the falling response of the transmitter above its resonance.

Sensitivity:—
Tested with associated horn and acoustic channel—approximately 86 db relative to 1 microvolt open circuit voltage per dyne per square cm of free field pressure at 1000 c/s.



TYPE 4048



TYPE 4049

Resistance and Feed Current:—
90 ohms at 40 mA feed current.
Weight (excluding cords and plugs):—
4048 Receiver: 2.6 oz (74 g)
4049 Receiver: 4.4 oz (125 g)
4408 Telephone Set: 4.2 oz (119 g)
4409 Telephone Set: 6.0 oz (170 g)

Ordering

For flexibility in ordering, cords and plugs are not included in the headset codes, if required they should be ordered separately but can be supplied ready fitted.

Standard Telephones and Cables Limited

TELEPHONE SWITCHING DIVISION

OAKLEIGH ROAD, NEW SOUTHGATE, LONDON N.11

Telephone: Enterprise 1234 *Cablegrams:* Relay, London, W.C.2 *Telex:* 21612

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Address overseas marketing enquiries to: Export Marketing Manager, STC House, 190 Strand, London, W.C.2 England

February, 1966 *Printed in England by Southern Press (Printers) Ltd.*

Private Manual Branch Exchange PMBX 2+6

Post Office

DLC 300

Several sizes of cordless switchboard can be provided to meet a wide range of business requirements (see table on back page).

This leaflet describes the switchboard for the business that needs up to two exchange lines and six extensions.

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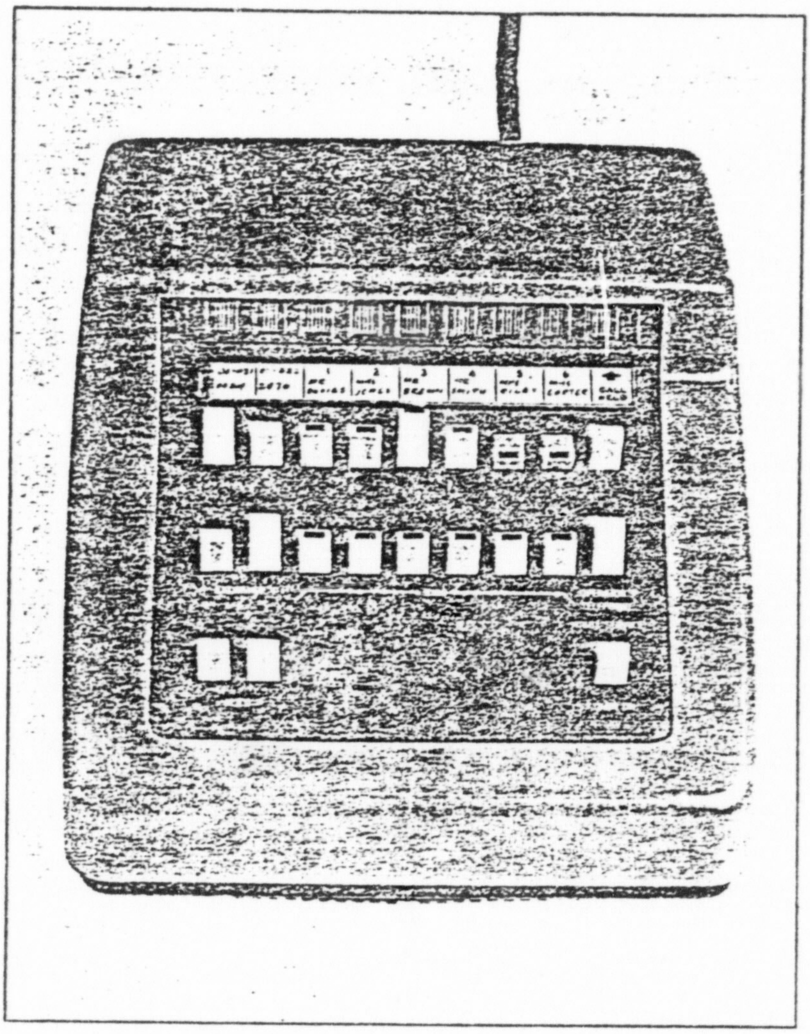

How it operates

Each exchange line, each extension, and the operator's telephone, has a signalling lamp with a column of keys beneath it. The keys are used to answer and connect calls.

By pushing keys in the top row up or down, or keys in the second row up, three independent connecting circuits can be used. In the photograph left, for example, exchange line 1 is connected to extension 3, extension 5 is connected to extension 6, and the operator's telephone to exchange line 2.

An exchange call can be held if the operator has to leave the line to make an enquiry, by operating the associated 'hold' key. The lamp above the operator's keys glows continuously while either exchange line is held.

Extensions are rung by pressing down the associated key in the second row.

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Facilities

Two exchange lines and up to six extensions can be connected to the switchboard.

The extensions can be internal, external or inter-switchboard although those other than internal are limited to three. Private circuits can also be connected in place of external extensions.

Each extension telephone has a press-button which can be used to signal the operator while a call is in progress. The operator can then assist as necessary or transfer the call to another extension.

The operator can also speak to an extension, without being overheard while holding an exchange call on the same connecting circuit. A glowing lamp reminds the operator that the exchange line is being held.

Three separate calls can be in progress at the same time, without overhearing.

All calls are signalled with lights on the switchboard.

An alarm buzzer, which operates with the lights, can be switched on or off, as required. It can be set to loud, medium or soft output by the installation engineer.

Power for signal lights and bells is obtained from a unit connected to the mains.

If there is a mains failure, exchange calls in progress remain connected. Fresh incoming calls on the first line ring the bell in the operator's telephone. The second line can be switched through so that further incoming calls ring one of the extensions.

Night service is provided by connecting each exchange line to an extension and switching on the night service key.

Extension arrangements to plans 1, 1A, 9, 12A, 105, 105A, 107 and 107A can be provided on switchboard extensions.

General information

This switchboard unit, designed to stand on a desk or table, weighs 12 lb (5·4 kg).

It works from a power unit connected to a 3-pin socket outlet of at least 2-amp rating, provided by the customer.

The power unit, together with a connexion box, is usually mounted on a wall in any convenient position, provided that the cable run from the switchboard does not exceed 100 ft (30·5 m).

For an installation with only internal extensions this equipment weighs 17 lb (7·7 kg). When external extensions and circuits with special telephone arrangements are provided, a slightly larger power unit, weighing 20 lb (9·1 kg), is required, together with an auxiliary unit, weighing 10 lb (4·5 kg), for each circuit (limited to three).

The cases of the power and auxiliary units are elephant grey, and the dimensions are shown overleaf.

A two-tone grey telephone, which matches the switchboard, is provided for the operator. A grey lightweight headset (shown in the photograph) can also be provided, for a small additional charge.

Tablephones in two-tone grey, two-tone green, light ivory, topaz yellow, lacquer red, concord blue, or black can be provided on extensions. If wallphones are required, the choice of colour is limited to two-tone grey, light ivory, or black.

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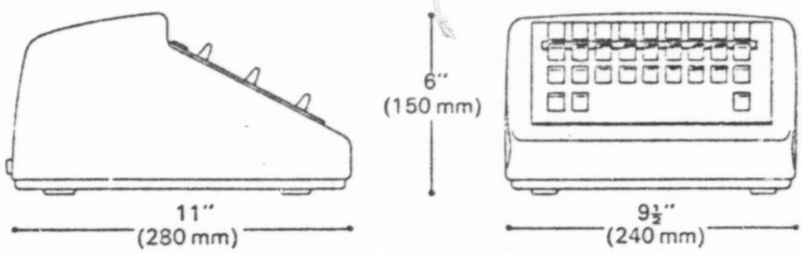
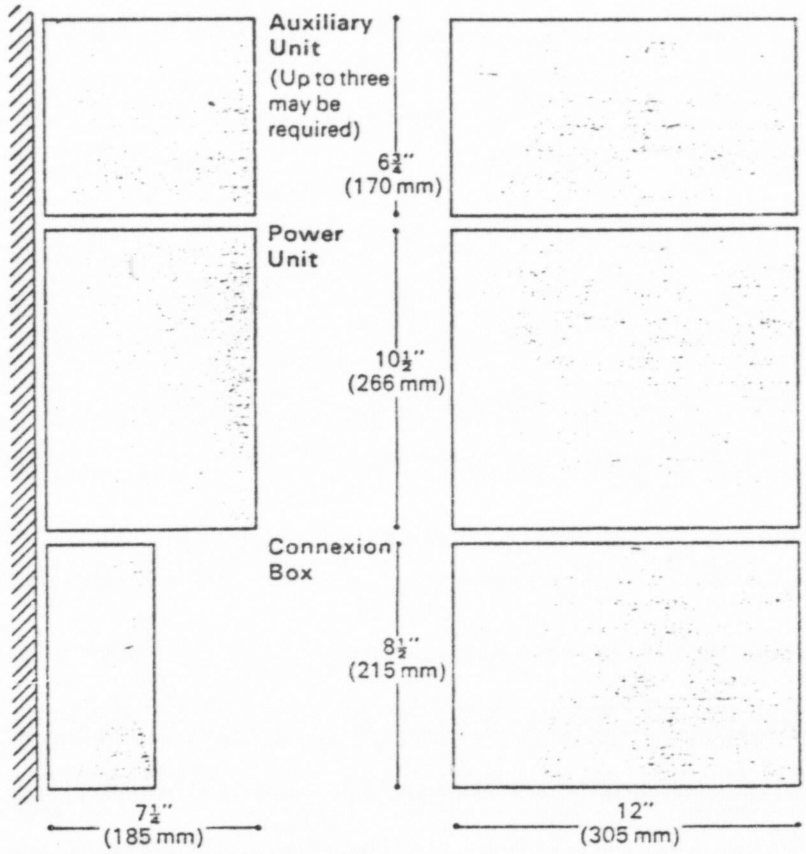
Dimensions

Switchboard



Wall-mounted equipment



Range of PMBX cordless switchboards

Type	Exchange lines	Extensions	Calls possible at same time	Descriptive leaflet number
Desk-standing	2	6	3	DLC 300
Desk-standing	3	12	5	DLC 301
Desk-standing	4	18	7	DLC 302
Panel-mounted	3	12	5	DLC 320
Panel-mounted	5	25	7	DLC 320

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Please note
We do our best to supply our customers with the apparatus they ask for but we may have to provide apparatus which does not accord exactly with the descriptions and illustrations in this leaflet.

Rental and connexion charges are quoted in DLC 1 the preface sheet for section C descriptive leaflets.

Your Telephone Sales Office will gladly supply any further information The address and telephone number are shown in the preface of your telephone directory.

Printed in England by Robor Ltd

Post Office

Private Manual Branch Exchange PMBX 3+12

DLC 301

Several sizes of cordless switchboard can be provided to meet a wide range of business requirements (see table on back page).

This leaflet describes the switchboard for the business that needs up to three exchange lines and twelve extensions.

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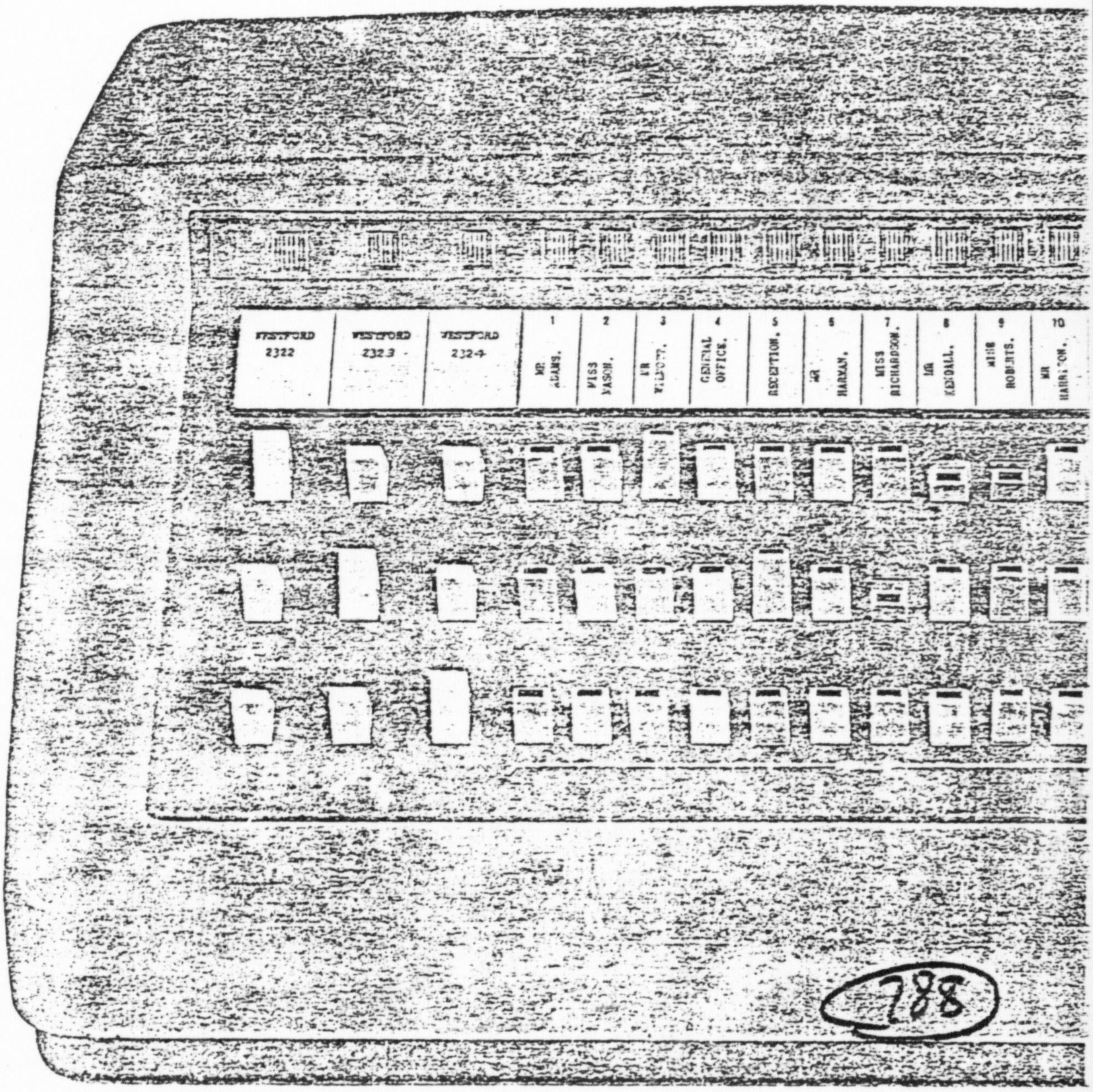
How it operates

Each exchange line, each extension, and the operator's telephone, has a signalling lamp with a column of keys beneath it. The keys are used to answer and connect calls.

By pushing keys in the top and middle rows up or down, or keys in the third row up, five independent connecting circuits can be used. In the photograph below, for example, exchange line 1 is connected to extension 3; extension 8 to extension 9; exchange line 2 to extension 5; extension 7 to extension 11; while the operator is dealing with a call on exchange line 3.

Exchange line calls are held automatically if the operator has to leave the line to make an enquiry. The lamp above the operator's keys glows continuously while any exchange line is held.

Extensions are called by pressing down the associated key in the third row.

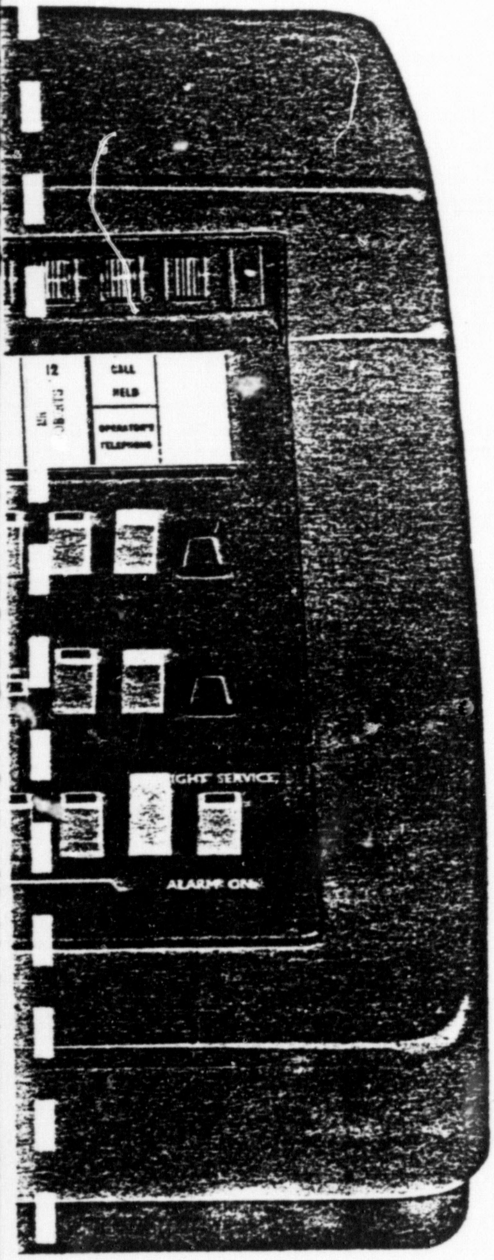


Facilities

Up to three exchange lines and up to twelve extensions can be connected to the switchboard.

Extensions can be internal, external, or inter-switchboard although those other than internal are limited to six. Private circuits can also be connected in place of external extensions.

Extension telephones can be provided with dials so that calls can be dialled direct when the operator has connected the extension to an exchange line.



Each extension telephone has a press-button which can be used to signal the operator while a call is in progress. The operator can then assist as necessary or transfer the call to another extension.

The operator can also speak to an extension, without being overheard, while holding an exchange call. A glowing lamp reminds the operator that the exchange line is being held.

If an exchange call is received on a line before the operator has been able to disconnect it from a previous call, the new call is automatically intercepted at the switchboard. A lamp glows on the switchboard to warn the operator, and the extension to which the line is still connected is not rung.

Five separate calls can be in progress at the same time, without overhearing.

All calls are signalled with lights on the switchboard.

A buzzer, which operates with the lights, can be switched on or off, as required.

Power for signal lights and bells is obtained from a unit connected to the mains.

If there is a mains failure, exchange calls in progress remain connected. A fresh incoming call on the first exchange line rings the bell in the operator's telephone. The second and third lines can each be switched through to an extension so that calls can be made and answered at those telephones.

A stand-by power supply together with a mains-failure warning lamp can be provided for an additional charge.

Night service is provided by connecting each exchange line to an extension and switching on the night service key. This will also cut off the switchboard alarm and lamps.

Extension arrangements to plans 1, 1A, 9, 12A, 105, 105A, 107 and 107A can be provided on switchboard extensions.

General information

This switchboard unit, designed to stand on a desk or table, weighs approximately 33lb (15kg).

It works from a power unit connected to a 3-pin socket outlet of at least 2-amp rating, provided by the customer.

The power unit, together with a connexion box, is usually mounted on a wall in any convenient position, provided that the cable run from the switchboard does not exceed 100ft (30.5m).

For an installation with only internal extensions this equipment weighs approximately 20lb (9kg). When external extensions and circuits with special telephone arrangements are provided, a larger power unit, weighing approximately 40lb (18kg) is required, together with an auxiliary unit, weighing approximately 10lb (4.5kg) for each circuit (limited to six).

The cases of the power and auxiliary units are elephant grey, and the dimensions are shown overleaf.

A two-tone grey telephone, which matches the switchboard, is provided for the operator. A grey lightweight headset (shown in the photograph) can also be provided, for a small additional charge.

Tablephones in two-tone grey, two-tone green, light ivory, topaz yellow, lacquer red, concord blue, or black can be provided on extensions. If wallphones are required, the choice of colour is limited to two-tone grey, light ivory, or black.

Trimphones can be provided on extensions for a small additional rental. There is a choice of three colours – grey, blue and green – each is a dual-tone with the handset in the darker tone.

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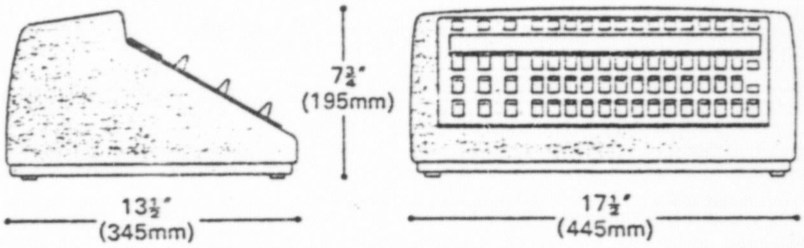
Range of PMBX cordless switchboards

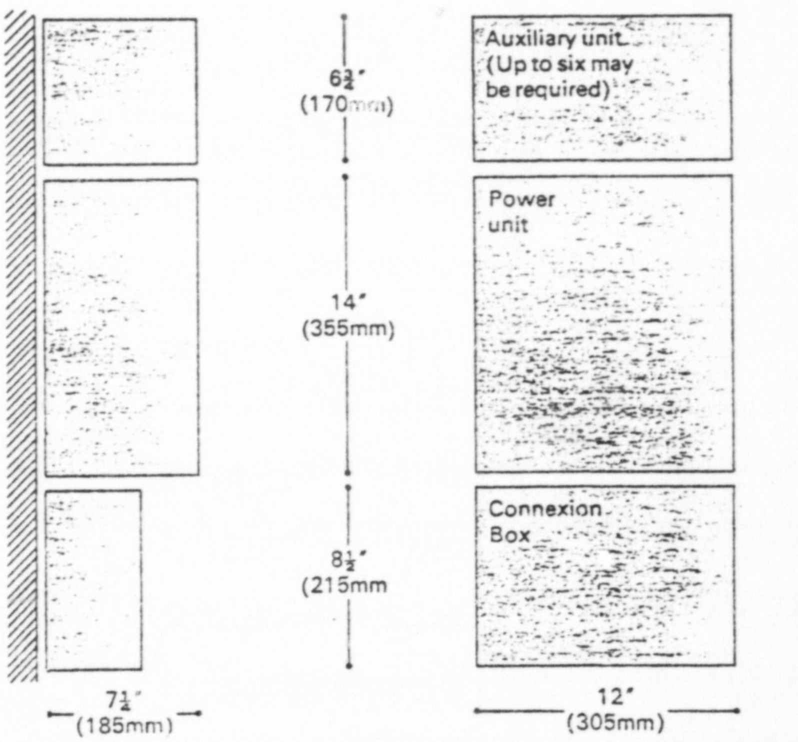
Type	Exchange lines	Extensions	Calls possible at same time	Descriptive leaflet number
Desk-standing	2	6	3	DLC 300
Desk-standing	**3**	**12**	**5**	**DLC 301**
Desk-standing	4	18	7	DLC 302

Dimensions

Switchboard



Wall-mounted equipment



Please note
We do our best to supply our customers with the apparatus they ask for but we may have to provide apparatus which does not accord exactly with the descriptions and illustrations in this leaflet.

Value Added Tax
From 1st April 1973 value added tax will be payable for telecommunications services and will be added to the total of charges on customers' bills.
Rental and connexion charges are quoted in DLC [illegible] the preface sheet for section C descriptive leaflets.

Your Telephone Sales Office will gladly supply any further information. The address and telephone numbers are shown in the preface of your telephone directory.

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Post Office
Telecommunications

Types of Telephone Instruments

August 1973

Descriptive Leaflet **DLE 500**

This leaflet describes the types of telephone which can be provided to suit customers individual tastes, and in certain cases, specialised needs.

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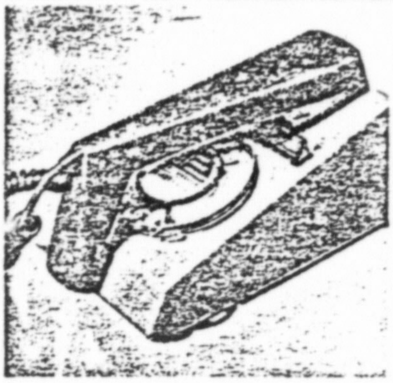
Tablephone

The standard table telephone can be provided in seven colours: blue, yellow, red, two-tone green, two-tone grey, ivory, black. Each instrument is supplied with an extensible coiled handset cord which extends from 250mm to 1670mm (10" to 66"). There is a carrying handle beneath the handset and the dial has black figures on a silver background with a clear plastic finger plate.



Trimphone

A lightweight table telephone which uses a tone caller in place of the conventional bell can be provided for a small additional rental. A volume control allows the tone-caller to be adjusted from soft to loud. The dial, which is illuminated, has a clear plastic finger plate, and the handset rest serves as a carrying handle. Trimphones are available in blue, green and grey with the handset in a darker shade.

Lightweight headset

In place of a telephone, the customer can, for a small additional charge, have a headset with one or two earpieces, a dialling unit and a plug and socket.
The headset can also be associated with most other Post Office apparatus, including an ordinary telephone.

Wallphone

Wall-mounted telephones available in two-tone grey, ivory or black are particularly suitable where space is limited.

Explosive atmospheres telephone

These telephones have been designed for use in locations where under abnormal circumstances an accumulation of certain types of explosive gas could create a possible risk of explosion. They are fully described in descriptive leaflet DLE 501.

Pendant Telephone

This grey telephone handset suitable for fitting in the knee-hole of a desk or on a wall to save space, can be provided for a small additional rental. A separate matching drawer type dial unit can be fitted beneath the edge of the desk. The bell is wall-mounted in a grey case and may be placed in any convenient position.

Weatherphone

A wall-mounted telephone contained in a grey metal case, can be provided for use at outdoor locations. It may be used on exchange lines and switchboard extensions. It cannot be provided on plan arrangements or shared service lines. The hinged door is finished in blue and can be provided with a lock if required. The telephone, which contains an integral bell, may be fitted on a wall or to a pole. The case measures 318mm by 145mm by 168mm ($12\frac{1}{2}$" by $5\frac{3}{4}$" by $6\frac{5}{8}$"), and the total weight is 5 kgs ($10\frac{1}{2}$ lbs).

Please note
We do our best to supply our customers with the apparatus they ask for but we may have to provide apparatus which does not accord exactly with the descriptions and illustrations in this leaflet.

Rental and connexion charges are quoted in DLE 1 the preface sheet for Section E descriptive leaflets.

Your Telephone Sales Office will gladly supply any further information. The address and telephone number are shown in the preface of your telephone directory.

Printed by Focus Offset Ltd.

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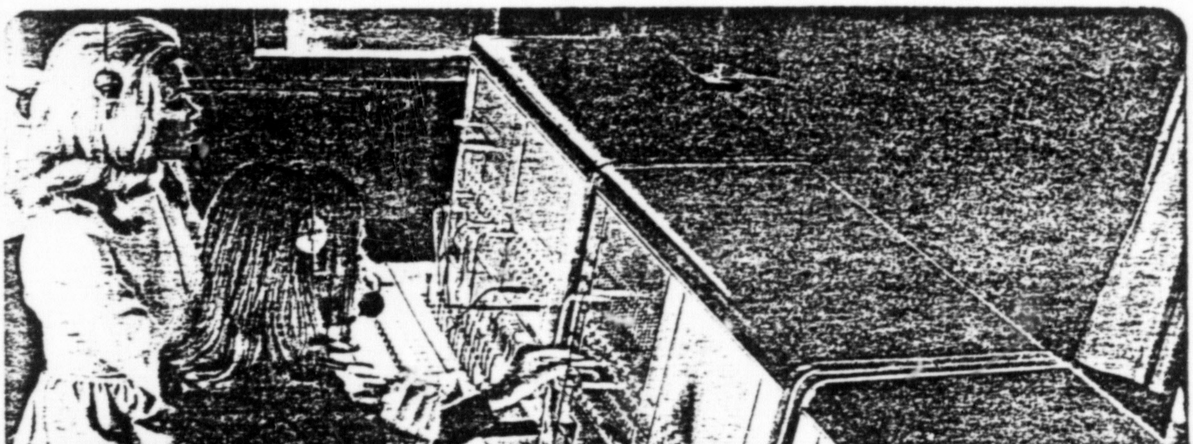
Private Manual Branch Exchange (PMBX 4)

DLC 330

Multiple Position

To meet the telephone needs of the large organisation in which all extension users require personal service, the PMBX 4 with two or more switchboard positions can be provided.



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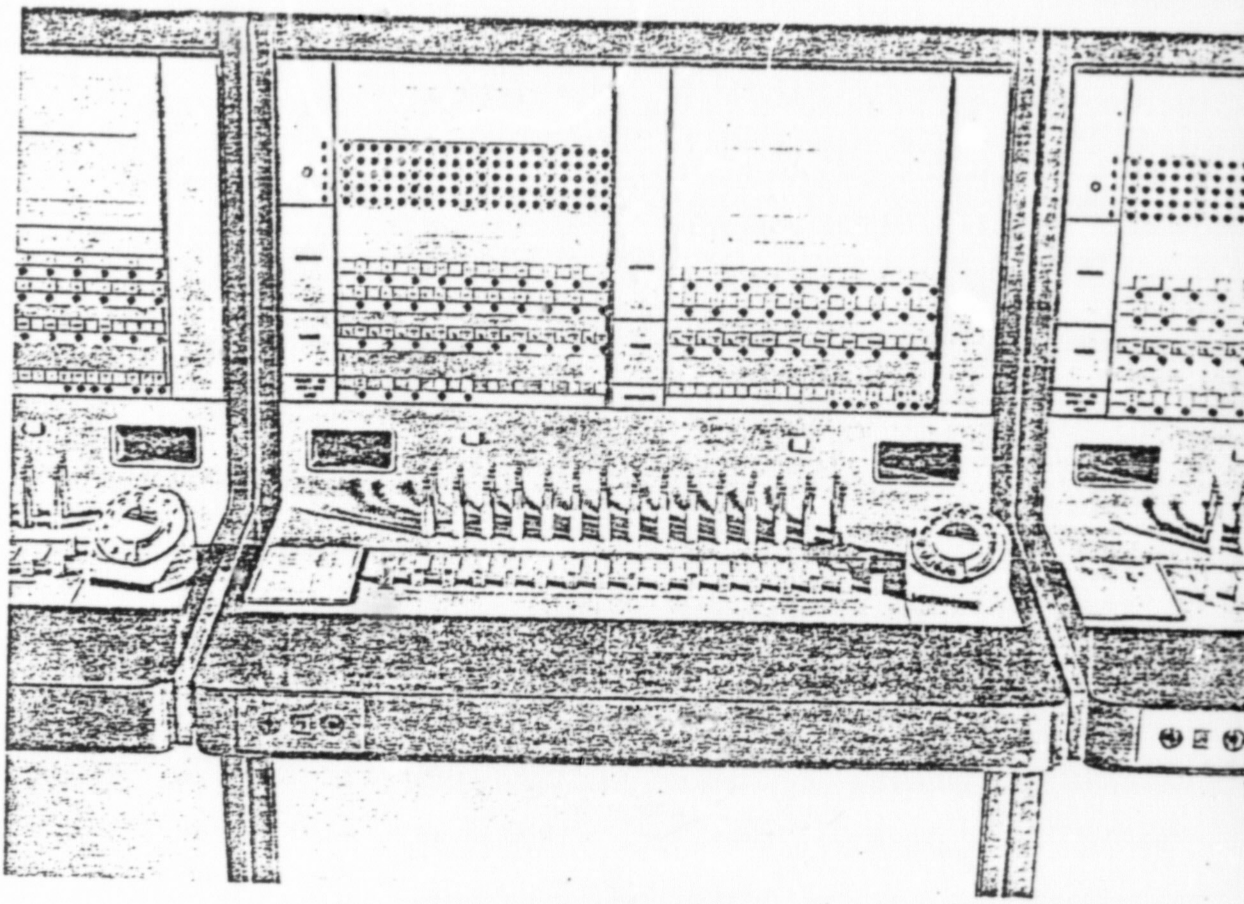

Capacities

The number of operating positions required will depend on the needs of the organisation.

Two positions are generally required for up to 20 exchange lines and 80 extensions, and 3 or 4 positions for the maximum capacity of 40 exchange lines, 10 private or interswitchboard circuits, and 200 extensions.

The maximum number of positions that can be joined together to form a suite is four.

Your Telephone Sales Office will give advice on the most suitable installation.

Description

Each exchange line, extension, private circuit and interswitchboard circuit has a calling lamp and answering jack. These can be arranged out of numerical sequence over the multiple positions to distribute the incoming calls evenly between the operators.

Additionally, as each position has two panels of jacks, which accommodate all extension circuits arranged in numerical sequence, each extension circuit is available to each operator.

Each position, when unstaffed, can be coupled to the position on its left.

Ten cord circuits are normally provided on each position to allow 10 calls to be connected at the same time. The number of cord circuits can be increased to a maximum of 15.

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Switchboard Facilities

All calls are signalled by lights and, if required, an alarm buzzer. The buzzer, which is set to low, medium or loud volume of sound, by the engineer who installs the switchboards, can be switched off by means of a key.

Visual indication of the next exchange line to be used for making calls can be provided. When provided, if the first line is engaged an illuminated arrow points to the next available line.

Automatic ringing is applied when a calling cord is plugged into an extension jack. Ringing continues until the extension answers.

Continuous ringing can be obtained on an answering cord if required.

An exchange call can be held by the operator while speaking to an extension, and the caller can be prevented from overhearing the conversation.

The operator can interrupt a call to ask if the extension will take another call.

Incoming exchange calls are prevented from ringing an extension when the PMBX operator has not been able to disconnect the cords from a previous exchange line call to that extension. A flashing signal draws the operator's attention to the new exchange line call.

In automatic exchange areas cyclometer-type meters can be provided:
Cord circuit trip meters to indicate units used on individual calls.
Exchange line totals meters to record total units used on individual exchange lines.
Trip or totals meters to record units used on predetermined extensions.

Totals meters are useful for checking the units used on a series of calls, but for technical reasons they are unsuitable for checking the total metered units which will appear on the telephone bill.

Night service is arranged by connecting exchange lines to selected extensions.

A grey lightweight headset is provided for each position. A twin socket on each position allows for an extra headset to be plugged in for training purposes.

Switchboard dials can be changed by the operator and a spare dial is provided for each installation.

Extension Facilities

Each internal or external extension telephone has a press-button so that the operator can be recalled.

Extensions can be provided with dial telephones so that calls can be dialled direct when the extension is connected to an exchange line.

On an outgoing exchange line call, the line is released as soon as the extension handset is replaced.

Extension arrangements to plans 1, 1A, 2, 4, 9, 12A, 105, 105A, 107 and 107A can be provided on switchboard extensions. Telephones on extension arrangements plans 2, and 9, also the main telephones of extension plans 12A, 105, 105A, 107 and 107A are available in black, two tone grey or ivory.

Tablephones in two-tone grey, two-tone green, light ivory, topaz yellow, lacquer red, concord blue, or black can be provided on other extensions.

When wallphones are provided, the choice of colour is limited to two-tone grey, light ivory, or black.

Trimphones can be provided on extensions for a small additional rental. The telephone is available in grey, blue, or green; each is a combination of two tones, with the handset in the darker tone.

General Information

The switchboards are finished in grey plastic laminate. The working surfaces and face equipment are in french grey, and the surrounding panels in elephant grey.

The switchboards are free standing and need about 900mm (3') clear space behind them for maintenance purposes. There should also be at least 900 mm (3') clearance to one side of the switchboards and 300mm (1') on the other, and there should be no obstruction of the space above the switchboards.

The dimensions of a single position are 730mm (2'4¾") wide, 850mm (2'9½") deep and 1220mm (4') high, and it weighs approximately 205 kg (450 lb).

The equipment is mains-powered and works from a 3-pin switched socket outlet of at least 13-amp rating provided by the customer, except when the switchboard load exceeds 12 amps in which case a battery power supply is provided.

On a mains-powered installation, in the event of a mains failure, a restricted service is still possible. Exchange calls in progress remain connected, and the operator can still make and receive exchange calls.

Most of the equipment is contained inside the switchboard, but the power unit, or batteries if provided, and ringing and signalling units are separate. Power units, ringing and signalling units are usually wall-mounted in a convenient position near the switchboard. If many signalling units are necessary, the equipment can be floor standing.

The simplest installation for example requires a wall-space of approximately 750mm by 750mm (2'6" by 2'6"), and stands out about 300mm (1').

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Please note
We do our best to supply our customers with the apparatus they ask for but we may have to provide apparatus which does not accord exactly with the descriptions and illustrations in this leaflet.

Rental and connexion charges are quoted in DLC 1 the preface sheet for section C descriptive leaflets.

Your Telephone Sales Office will gladly supply any further information. The address and telephone number are shown in the preface of your telephone directory.

Printed by Oxley Press London and Nottingham

Daniel W. Martin

STUDY AND INVESTIGATION

OF SPECIALIZED ELECTRO-ACOUSTIC

TRANSDUCERS FOR VOICE COMMUNICATION

IN AIRCRAFT

Contract AF33(616)-3710 – FINAL REPORT

Task No. 43060

February 1959

WESTERN ELECTRO-ACOUSTIC LABORATORY, INC.

LOS ANGELES, CALIFORNIA

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DEFENDANT'S EXHIBIT

NO. H

PENGAD - Bayonne, N.J.

STUDY AND INVESTIGATION OF SPECIALIZED ELECTRO-ACOUSTIC TRANSDUCERS FOR VOICE COMMUNICATION IN AIRCRAFT

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Los Angeles, California

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2.0 DESIGN OF THE EXPLORATORY PROGRAM

2.1 Objective of the Program

The basic purpose of the program was to discover and explore improved means for voice communication during Air Force operations. Flight operations at high altitude using auxiliary respiratory equipment, and in high level noise fields are of first concern. Improvements are desired which will:

(a) decrease the size, weight and discomfort associated with the equipment which must be worn on or about the head of the flier;

(b) achieve as good or better intelligibility in aircraft noise as that presently provided by the AN/AIC-10 interphone system;

(c) be adaptable for use with the AIC/10 system, so as to encourage interchangeability of new components in the older systems.

2.1.1 Although the transducers, i.e. microphones, headphones, etc., of the interphone equipment are not themselves very heavy, it is believed that their size, and especially their location, is responsible for increased weight and size in the helmet. Hence, if otherwise unoccupied space in the helmet could be used for the transducers, instead of the location on the ears, the width of the helmet could be reduced. This is important not only for weight, but also for reduction of aerodynamic forces in bail-out. Similarly, the microphone position near the lips not only is a nuisance in speaking, but also interferes with feeding and necessitates mechanism for external control of the microphone position. The weight of the complete headgear is not only a factor in the movement and endurance of the flier, but also limits the performance of the aircraft by virtue of the maximum accelerations under which a man can support or control the additional weight on his head.

2.1.2 The discomfort of flying headgear is to a large degree attributable to the interphone equipment. There are many degrees of discomfort. It can hardly be expected that the flier's environment can be kept "comfortable." The degree of discomfort which we are concerned with here is in the category of intolerable. Specifically, the complaint has been called "ear torture." It is reported as being of such degree as to detract from the operational effectiveness of flying personnel on long range bombing missions. If a man is supposed to wear his helmet for the duration of a flight, but cannot because of intolerable pain, and without it he is not only inadequately protected, cannot be adequately supplied with oxygen, and is inadequately prepared for emergency

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flight conditions, then the condition is an operational hazard. Hence, elimination of discomfort has been an urgent necessity.

2.1.3 The intelligibility provided by present AIC-10 equipment if properly used is adequate for the aircraft noise which exists in military aircraft today. However, it is important in the search for smaller and lighter weight equipment, especially the transducers, that the present performance should not be sacrificed. Furthermore, there is good reason to believe that the future of aircraft development may have increased noise in store. The flier must be protected from this increasing noise for his safety and to make communication possible.

2.1.4 Typical of any complex system, the provision of communication to and from the flier is only one of the many services which impress conflicting demands upon space and perception. Consequently, several different functions must be considered and coordinated. The following are examples:

2.1.4.1 Respiration requirements easily conflict with communication requirements because, especially in regard to the vocal function, the same space is involved. In the open circuit oxygen supply system there is an optimum and rather small volume of dead air space which can be tolerated around the mouth, and the mask must seal. Also, the oxygen valving creates noise. These conditions impose a peculiar acoustic load and stress on the vocal process and limit achievable attenuation of external noise. The closed circuit ventilation system tolerates a much larger volume between face and helmet, permitting more normal vocal loading, and the prospect of improved helmet attenuation. However, the total air flow is greater, and noise generation by this entering flow must be carefully controlled in design. Any proposed advances in communication must be carefully correlated with respiration requirements. The respiration section of the Aero Medical Laboratory has been our advisor.

2.1.4.2 Wearability problems associated with flying helmets involve size, shape, fit and head contact, all of which influence possible helmet attenuation of external noise. Comfort, or more properly the limitation and control of discomfort, although stressed as a primary factor in the exploratory contract, is not a subject which has attained scientific or quantitative stature, although a quantitative comfort tolerance limit of forty hours duration was agreed upon as an essential objective. After considerable discussion it was decided that a quantitative approach to discomfort control could not be undertaken as a part of this contract. The Anthropology section of the Aero Medical Laboratory has been our advisor with particular coordination through the office of Dr. H. O. Parrack.

2.1.4.3 Considerations of weight and support of the helmet, which are the primary factors in attenuation, are limited

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by the considerations of dynamic accelerations in flying.

The Dynamics section of the Aero Medical Laboratory has been our advisor.

2.1.4.4 The high level noise environment inside military aircraft is the principal deterring factor in communication. The history has been one of steady increase insofar as the interference with speech is concerned. It is difficult to predict the noise field in which future aircraft communication must operate: the propulsion units are steadily increasing, but their noise is left behind in supersonic flight; speed increases aerodynamic noise, but higher altitude leaves the atmosphere below; a pressurized cabin might allow direct speech communication, but in an emergency, communication must continue in a pressurized helmet. Hence, the noise field will depend greatly upon operating conditions. The Aircraft Laboratory and the Acoustics section of the Aero Medical Lab. have been our advisors in regard to noise environment.

2.1.4.5 Improvements in communication equipment, especially the transducers for speech projection and reception, are the objective of the program. These must be conceived within the framework of limitations described above. The present status and detailed objectives for this program are best judged by reference to the large body of experience and the background of reports on recent progress available from the Communication and Navigation Laboratory and its personnel who are responsible for the present program.

2.2 The Panel of Experts

It has been our sincere belief that there are many individuals and groups throughout the country who can make a valuable contribution to this program, and that, in contrast, there is no one organization which can bring to bear all available talent. Therefore, upon request of the C and N Lab through the buyers, even before the contract was granted we set about it to organize a guiding group to advise and direct the activities of the program. This group of consultants has functioned throughout the program and is known as the Panel of Experts:

Harvey Fletcher-Professor of Electrical Engineering-Brigham Young University, Provo, Utah, formerly Director of Acoustical Research of Bell Telephone Laboratories.

William B. Snow-Consulting Acoustical Engineer, Santa Monica, California; formerly Director Physical Research, Vitro Corporation, Acoustical Engineer Bell Telephone Laboratories.

Wayne Rudmose-Professor of Physics, Southern Methodist

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University, Dallas, Texas; formerly Associate Director, Electro-Acoustic Lab. Harvard University.

Gordon Peterson-Professor, Speech Department-University of Michigan, Ann Arbor, Michigan; formerly Bell Telephone Laboratories, Psycho-Acoustic Laboratory, Harvard University.

Daniel W. Martin-Director Acoustical Research, Baldwin Piano Company, Cincinnati, Ohio; formerly-Acoustical Engineer-R. C. A.

Cyril M. Harris-Professor of Electrical Engineering, Columbia University, New York; formerly Bell Telephone Laboratories.

Bolt, Beranek and Newman, Cambridge, Mass., represented by Leo L. Beranek, formerly Director-Electro-Acoustic Laboratory, Harvard University.

Francis M. Wiener, Bell Telephone Laboratories, formerly Electro-Acoustics Lab, Harvard University.

J. C. R. Licklider, formerly Psycho-Acoustics Lab, Harvard University.

Radio Corporation of America, Camden, N. J., represented by Willard F. Meeker

Martin L. Touger

Armour Research Foundation, Chicago, Illinois, represented by Robert W. Benson, formerly of Central Institute for the Deaf.

Western Electro-Acoustic Laboratory, Los Angeles, California, represented by Paul S. Veneklasen, formerly of Electro-Acoustic Laboratory, Harvard University.

The specific functions of the Panel of Experts are:

a. Discover all possible means for speech projection and reception;

b. Devise or define critical tests for the relative effectiveness of such means;

c. Suggest exploratory research studies for evaluation of untried or novel means of communication;

d. Evaluate the results of these exploratory studies.

2.2.1 Other Cooperating Groups:

In addition to the formally organized Panel of Experts, the program enlisted and is indebted for the cooperation of other individuals and groups who assisted because of mutual occupation or interest in the problem.

George A. Miller, Professor of Psychology, Harvard University, Cambridge, Mass.; formerly of Psycho-Acoustic Lab.

U. S. Navy Electronics Laboratory, San Diego, California, represented by Robert S. Gales and John C. Webster.

Air Force Cambridge Research Center, Bolling Air Force Base, Washington, D.C., represented by Karl D. Kryter, formerly of Psycho-Acoustic Laboratory, Harvard University.

Haskins Laboratories, New York, represented by Franklin S. Cooper, Alvin M. Liberman, and Katherine Harris.

Castle Air Force Base, Merced, Calif., represented by

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Lt. Col. Earl Udick and Capt. Jack Jean.
Theodore J. Schultz, Douglas Aircraft Company, Santa Monica.

2.3 Status of Equipment at Start of Program.

A more complete description of the characteristics and performance of the AN/AIC-10 intercommunication system is presented in Appendix 2.

Since our objective is improvement it is well to briefly summarize our starting position. The pertinent factors may be described as follows:

2.3.1 Noise Levels in Military Aircraft

Noise exposure in crew positions are shown in detail in Section 4.2.2 in connection with the choice of a suitable standard jet noise spectrum for our testing program. Typical values are as follows:

B52 during cruise-over-all-90db.
S.I.L. - 82db.
(S.I.L. = Speech interference level=average of 600/1200, 1200/2400, 2400/4800 CPS octave band levels)
Fighter cockpit during cruise-Over all-110 db.
S.I.L. - 98 db.

2.3.2 Size and Weight

The size and weight of the transducer elements currently incorporated in the AIC-10 system at the beginning of this program were:

Basic Microphone- M-32
Height=15/16"
Width=13/4"
Length=15/16"
Weight=68 grams
Basic Receiver- H-79/AIC
Diameter-2 inches
Thickness-1/2 inch
Weight-30 grams

2.3.3 Wearability

Reports from service use are one method of evaluating wearability. We found at the start of the program that the standard AIC-10 issue helmet and interphone equipment was rarely used; rather crew men improvised and tailored their own gear from any available components such as cushions, oxygen masks, soft flying helmets, etc. to suit their own fancy and desires as to fit and comfort. The report was in general very unsatisfactory, the primary reason being described as ear torture, with a strong aggravating factor the difficulty of maintaining uniform temperature at crew positions. Excessive temperature or humidity greatly increased the distress with painful headgear.

It is difficult to quantitize discomfort. Reasonable

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estimates based upon the time for cushions to become intolerable were:

3 hours for the original cushions used with the H70 or H75 headsets.

6-8 hours for the so called "RCA Donut" cushions (M123010)

18 hours for the large cushions supplied by International Latex in the k-1 helmet.

Chafing of the face by oxygen mask or noise shield was a common complaint.

On the other hand there is record of an experimental (laboratory) wearing of the P-type helmet with standard AIC-10 gear for 48 hours.

2.3.4 Articulation in Noise

Evaluation of the standard AIC-10 system by articulation tests in synthetic noise using PB word lists (Baldwin Report on Task 11, Contract No. AF33(03) 23313, April2, 1953) using the M-32/AIC microphone in the A-13A mask and the H-75/AIC Headset in a P-1A helmet show 68% intelligibility in a jet spectrum of 120 db. overall, 112 db. S.I.L., and 40% in 130 db. O.A., 122 db. S.I.L.

Field reports indicate no complaint regarding intelligibility of interphone equipment as such.

2.3.5 Amplifiers

The electronic circuits of the AIC-10 system are generally conceded to be excellent. Review by the Panel considers it to be a very admirable utilization of the techniques of automatic gain control, equalization and clipping. With this conviction our program concentrates on the transducers.

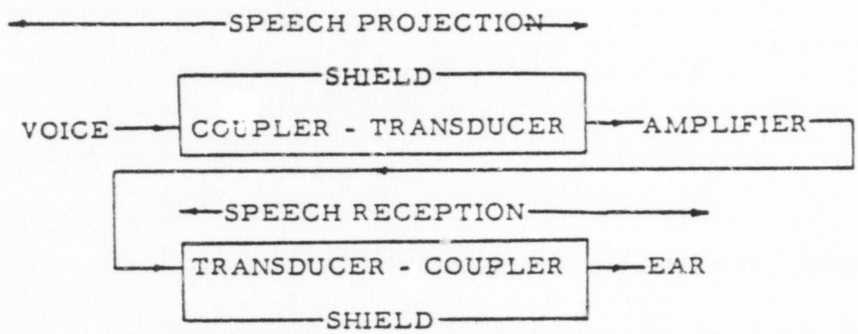
2.4 Transducer Chart

In approaching a program of this sort which is intended to be exploratory and as basic as possible it is important that one take steps to be sure that all possibilities have at least been considered. Doubtless this rarely if ever occurs in practice. However, as a conscious objective, it may be encouraged by the use of a formal analytical technique variously known as a "morphological approach" which is championed by the great physicist-astronomer Fritz Zwicky. This writer came in contact with this technique in connection with Rocket development-as we are both Consultants to the Aerojet General Corporation.

The morphological approach essentially says that if there are several factors which are applicable in combination to the solution of a problem, one should first methodically list all the techniques or approaches to each factor independently; then consider all the possible

combinations of techniques and factors which can possibly solve the problem. Out of this process in general come myriad combinations, many of which would not be conceived by a less formal approach, many of which will be obviously inapplicable. From this point it becomes a matter of experience and judgement to select the combinations which seem most likely to succeed within the financial limitations of the program.

In keeping with this approach we have attempted to generate a complete listing of the factors and techniques which are applicable to communication systems composed of the following elements:



These are all shown in the Chart of Table 11. Since the success of a system or its components may depend also on the proper choice of evaluation criteria, we have also listed, with the projection and reception factors, the various techniques and factors which may be used for evaluation.

2.5 Program Chart

Upon completion of the Transducer Chart, Table 11, a series of conferences was undertaken with the Panel of Experts to come upon a general agreement as to the possible combinations of transducer-coupler-shield which had promise of good performance, reduced size and weight, and improved comfort tolerance and should be the subjects of intensive investigation. The discussions leading to these conclusions, and the detailed design of the exploratory investigations are summarized in Appendix 1, and represent a thorough and stimulating re-appraisal of voice communication possibilities and techniques for evaluation. In the course of the Panel conferences we were at first at pains to elicit individual thinking and suggestions. Thereafter the contributions were combined into the form presented in Section A-1, and sent without identification of source to the Panel for criticism. As presented in Section A-1 the source or sources of each suggestion are indicated by initials with each comment.

The result of this preparation was the formulation of a program which is best shown in Chart form in Table 111. Portions of the work were sub-contracted in accordance with available capability.

Analysis of Transducer capability as such was assigned to Mr. Wm. B. Snow because of his long association with this

work at the Bell Telephone Laboratories. His work is reported in Section 3- , A-2- and A-3- . He in turn was assisted in the analysis of the potential capabilities of the electrostatic type projector by Dr. T. J. Schultz, whose work is reported in Appendix Section 3.4. .

New possibilities of speech reception systems which are closely associated with the head or ears were assigned to the Audio and Transducer Engineering section of the Radio Corporation of America, who were admirably experienced for this task by their long product improvement program in the development of the AN/AIC-10 system. Their work is reported in Sections 5- and A-5-.

Armour Research Foundation undertook two investigations: the potential improvement in the noise attenuation of flying helmets; and the possibility that useful communication can be achieved by the use of loudspeakers mounted external to the helmet, thus removing the receivers and cushions from the head. Their contribution is reported in Sections 6 and A-6-.

The balance of the program shown in the chart was undertaken by the Western Electro-Acoustic Laboratory, the prime contractor, and this included the comparative investigation of speech projection systems by means of physical performance measurement and articulation testing. Their work on microphones is reported in Sections 4- and A-5.

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Table ~~III~~ II

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Los Angeles 49, California
GRanite 7-9441

October 16, 1956

SPEECH PROJECTION FROM MAN

"ACOUSTO"-ELECTRIC TRANSDUCER TYPE	COUPLING MEANS TO SOURCE	NOISE FIELD EXCLUSION
1. Electrodynamic	1. Air-external to lips	1. Proximity to source
2. Electromagnetic	2. Probe tube to air microphone	2. Noise shield-oxygen mask
3. Ring armature magnetic	3. Throat contact	3. Helmet enclosure
4. Balanced or reed armature	4. Lip contact	4. Gradient cancellation
5. Variable resistance-carbon	5. Tooth contact	5. Impedance mismatch (relative sensitivity to air vs. solid transmission)
6. Piezoelectric	6. Air inside mouth	6. Helmet with acoustic window and auxiliary noise shield to be placed over window. Isolates breathing from microphone.
7. Electrostatic	7. Ear-direct air	7. Baffle
8. Magnetostrictive	8. Ear-probe tube	8. Tailoring of response
9. Electronic	9. Mechanical coupling to head	9. Clipping in transducer
10. Thermistor bead	10. Liquid coupling to head	10. [illegible]
	11. Air coupling to head	
	12. Chest contact	
	13. Air-turbulator in breath stream to enhance consonants	
	14. Artificial larynx to increase voice output.	

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EVALUATION CRITERIA - (Combination of transducer, coupler and noise excluder)

1. Net evaluation of intelligibility - - word articulation, noise-quiet
2. Physical (diagnostic) evaluation:
   a. Real voice frequency response - defines required equalization
   b. Dynamic noise attenuation
   c. Consonant/vowel ratio
   d. Speech/dynamic noise ratio (consonants and vowels)
   e. Speech sound alteration properties
   f. Behavior with altitude
3. Talker-listener acceptability
   a. Listenability: naturalness, pleasantness (lack of annoyance), speaker recognition, discomfort at high levels (speech area utilization)
   b. Wearability-discomfort
4. Size and weight potential

SPEECH RECEPTION TO MAN

ELECTRO-"ACOUSTIC" TRANSDUCER TYPE

1. Electrodynamic
2. Electromagnetic
3. Ring armature magnetic
4. Balanced or reed armature
5. Piezoelectric
6. Electrostatic
7. Magnetostrictive
8. Ionophone
9. Modulated air unit (modulate oxygen supply)
10. Thermophone
11. Electrophonics

COUPLING MEANS

1. Direct (air cavity) to ear
2. Probe tube to ear
3. Air cavity to head surface
4. Liquid coupling to head surface
5. Mechanical coupling to head surface
6. Distant air coupling (loudspeaker)
7. Loudspeaker in helmet-without ear seal
8. Loudspeaker outside helmet
9. Loudspeaker outside helmet with cavity coupling
10. Mechanical coupling to helmet.

NOISE FIELD EXCLUSION

1. Over-ear cushion
2. Semi-insert
3. Full insert (Harvin-tip)
4. Helmet
5. Earplug under cushion-mounted receiver
6. Active elements (electronic)

8/3A

EVALUATION CRITERIA

1. Net evaluation of intelligibility - - word articulation, quiet-noise
2. Physical evaluation:
   a. Real ear frequency response
   b. Maximum signal level
   c. Noise attenuation
   d. Masked threshold (combines a and c)
   e. Speech/noise ratio
   f. Behavior with altitude
   g. Signal supply requirements
3. Talker-listener acceptability
   a. Listenability
   b. Wearability
4. **Size and weight potential**

ELECTRONIC TREATMENT

1. Equalization or filtering:
   a. to reduce ratio of peak power to intelligence
   b. for maximum utilization of residual hearing area between pain ceiling and noise spectrum
2. Variable equalization as a function of intensity
3. Automatic gain control to maintain constant voice level
4. Altitude compensation
5. Speech clipping (instantaneous, delayed compression)

Advantages:
   a. Reduces ratio of peak power to intelligence
   b. Permits increase of average power
   c. Increases S/N at receiver
   d. Protection against overload of ear

Disadvantages:
   a. Adds distortion
   b. Produces bad quality

Possible Improvements:
   Frequency division channel clipping and filtering - - combination.

Table II

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Table II

WESTERN ELECTRO-ACOUSTIC LABORATORY
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TENTATIVE PROGRAM CHART
Contract AF33(616)-3710
October 15, 1956

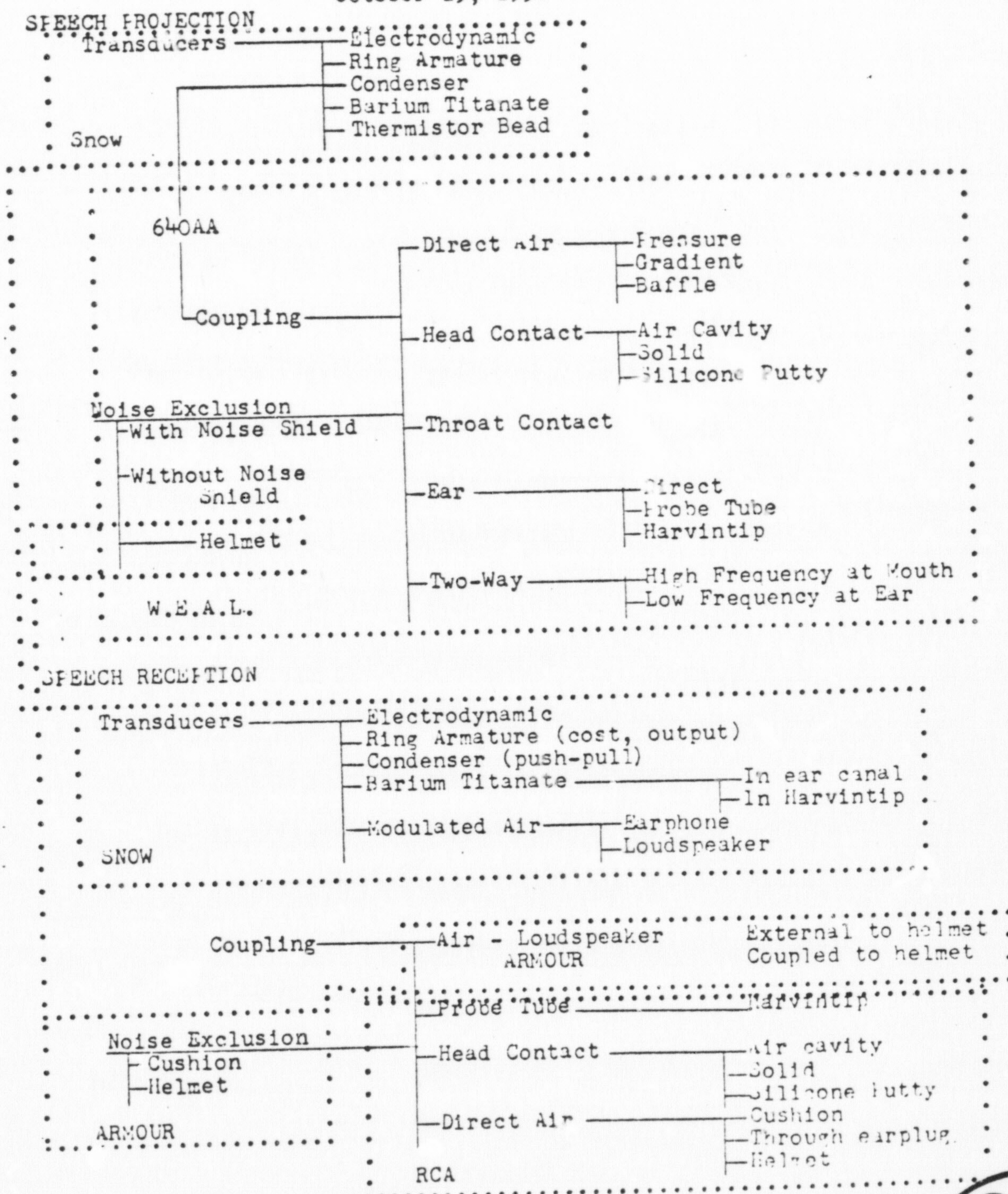

Table III

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